# Worcestershire Waste Core Strategy Background Document:

# Climate change and waste management in Worcestershire

## MARCH 2011

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The Council is preparing a *Waste Core Strategy*: a plan for how to manage all the waste produced in Worcestershire up to 2027. To help provide a robust evidence base for the Waste Core Strategy the Council has prepared a series of background documents. These outline current thinking and have informed the approach taken in the development of the Waste Core Strategy.

We welcome any comments you would like to make on any of the background documents during the *Publication Document (Regulation 27) Consultation.* The consultation will run from **22nd March – 4th May 2011**.

To make comments, request paper copies of the documents or for further information please contact:

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## Introduction

The weight of scientific evidence is now such that climate change is a politically accepted phenomenon that requires urgent, if not radical, actions. There is no doubt that addressing the challenges we face from climate change should be a key priority of planning, with Planning Policy Statement 1 stating that:

> *Effective spatial planning is one of the many elements required in a successful response to climate change. But used positively it has a significant contribution to make.* (1)

This background document is intended to inform the Waste Core Strategy and form a basis for addressing climate change issues. It considers potential mitigation and adaptation with regard to waste management.

Whilst climate change is an important element and is a principal concern for sustainable development, "local planning authorities should ensure that development plans promote outcomes in which environmental, economic and social objectives are achieved together over time" (2). This in mind, there are a range of other factors that also need to be properly considered in the determination of a balanced policy for sustainable waste management (3). This has been addressed throughout the development of the Waste Core Strategy and in the *Sustainability Appraisal*[1].

The background document was prepared in conjunction with the Waste Core Strategy and informed the *First Draft Submission Consultation document* and *Publication Document.* Consultations were undertaken on this document in October 2009 and September 2010.

In general consultees were happy with the broad approach taken to climate change issues as set out in this background document, however some updates were made following the consultation in October 2009.

No direct comments were made on the background document or the approach taken during the September 2010 consultation. Some comments were made on the policy approaches, however these were inline with the conclusion in this document. Changes have been made to the policy proposals, however it has not been necessary to update this document.

[1] The *Planning and Compulsory Purchase Act 2004* requires a Sustainability Appraisal of local Development Plan Documents to be carried out. It is used as a tool for integrating environmental and sustainability considerations into the preparation of the WCS, by considering the effects of implementing the WCS during its preparation and before its adoption. The SA is required systematically to assess the WCS against a framework of environmental, economic and social objectives.

# What is Climate Change?[2]

Climate change has always taken place; it occurs naturally, however most climate scientists agree that the increased rate of change we are experiencing now is for the most part due to human activities such as the burning of fossil fuels, like oil, gas and coal for energy.

The burning of fossil fuels, certain agricultural and industrial activities and decomposition of waste releases the greenhouse gases Carbon Dioxide ($CO_2$), Methane ($CH_4$), Nitrous Oxide ($NO_X$) and Hydro fluorocarbons (HFCs) into the atmosphere. To a certain extent many of these gases are present naturally and work like a 'greenhouse' trapping heat in the atmosphere and keeping the earth at a liveable temperature. The problem is that since the industrial revolution we've been releasing more of these gases than would occur naturally. This is resulting in a significant warming of the earth's surface and other associated changes in climate.

It is predicted that if no action is taken to limit greenhouse gas emissions, the earth's temperature will rise at a faster rate than at any time in the last 10,000 years. The human costs are expected to include food shortages, health risks and economic damage. In the UK, we are likely to see more extreme weather events, including hotter and drier summers, wetter and stormier winters, flooding and rising sea-levels (2). There will be permanent changes in the natural environment but also, and increasingly, substantial challenges to national prosperity and social cohesion. Globally, it is quite likely that the impacts of climate change will be felt first, and disproportionately so, by the most vulnerable in society (2).

Because greenhouse gases stay in the atmosphere for such a long time, ($CO_2$ can stay for up to 200 years), whatever we do we cannot escape some climate change, but the worst effects can be avoided if the greenhouse gases in the atmosphere are stabilised instead of being allowed to increase. In order to avoid the worst impacts of climate change, many scientists agree that we must reduce our climate change gas emissions by at least 80% before 2050. The UK Government has now adopted this as the national target (4) with an interim target of 34% reduction by 2022.

## What about Worcestershire?

Worcestershire's homes, businesses, public organisations and transport, generated an estimated 4.9 million tonnes of $CO_2$ in 2006 (4). The emissions are accounted for as follows (4):

- Domestic emissions: 29%
- Industrial and commercial emissions: 33%.
- Road transport: 36% (this is influenced by the impact of major road corridors passing through the County such as the M5 motorway).

The Worcestershire Partnership Climate Change Strategy aims to reduce emissions by 9% per capita from 2005 level by 2011 (5) (not including motorway emissions), with 7.1% from national efforts and 1.9% of this being from a local reduction. This would require reductions from the following sectors (5):

- Housing: at least 26,250 tonnes
- Transport: at least 21,000 tonnes

[2] This section is based largely on Worcestershire Partnership Climate Change Strategy Revision 2008: Consultation Document.

- Business, public sector & voluntary organisations: at least 27,750 tonnes

In Worcestershire high summer temperatures are expected to become more frequent and very cold winters are expected to be increasingly rare. The following changes in climate are likely to occur in Worcestershire by the 2080s (5):

- Annual mean temperature is likely to increase by 2.5-4.1$^{o}$C
- Winter precipitation is likely to increase by 21%-23% but summer precipitation may decrease by 29%-50%. Greater rainfall intensity and more rain on heavy rainfall days in expected.
- Summer cloud cover is predicted to decrease by 9-15%
- Winter wind speeds may increase by 4%-6%
- Annual relative humidity may decrease by 3%-7%, with the largest decrease in the summer.

Over half of the severe weather events that occurred in Worcestershire between 1997 and 2007 were associated with flooding/heavy rainfall, with the second most common being those related to heat (7). The dominant geology of the county is clay, which has a fairly low absorption capacity of water, increasing the likelihood of flooding incidences. If clay soils dry out in hot weather this increases the risk of subsidence (7).

# How does waste management contribute to climate change?

The greenhouse gases that are making the largest contribution to global warming are carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide (N2O). All three are produced during the management and disposal of wastes (3). In the UK Waste management is estimated to contribute around 2.5% of total greenhouse gas emissions (6) which is a considerable volume when compared to most other sectors of the economy.

The greenhouse gases methane and carbon dioxide are emitted from biodegradable waste as it decomposes. Of the greenhouse gas emissions from waste management, 89% $CO_2$equiv is from methane, 9% from carbon dioxide and 2% is from nitrous oxide[3] (3). The contribution of waste management to total UK methane emissions is very significant with it contribution and at an estimated 41% of all methane emissions (6) . Due to its significant impacts the European Commission see waste management policy as playing a part in achieving the targets agreed to under the UN Framework Convention on Climate Change (the Kyoto protocol) (3).

In the UK there are over 430 million tonnes of waste materials produced annually (7). In Worcestershire we produced:

- 299,863 tonnes of municipal waste in 2008 (8);
- 792, 415 tonnes of commercial and industrial waste in 2007 (9);
- An unknown amount, estimated to be 818,000 tonnes, of construction and demolition waste in 2006-07 (10).

There are a wide range of activities that may be employed in managing this waste, including:

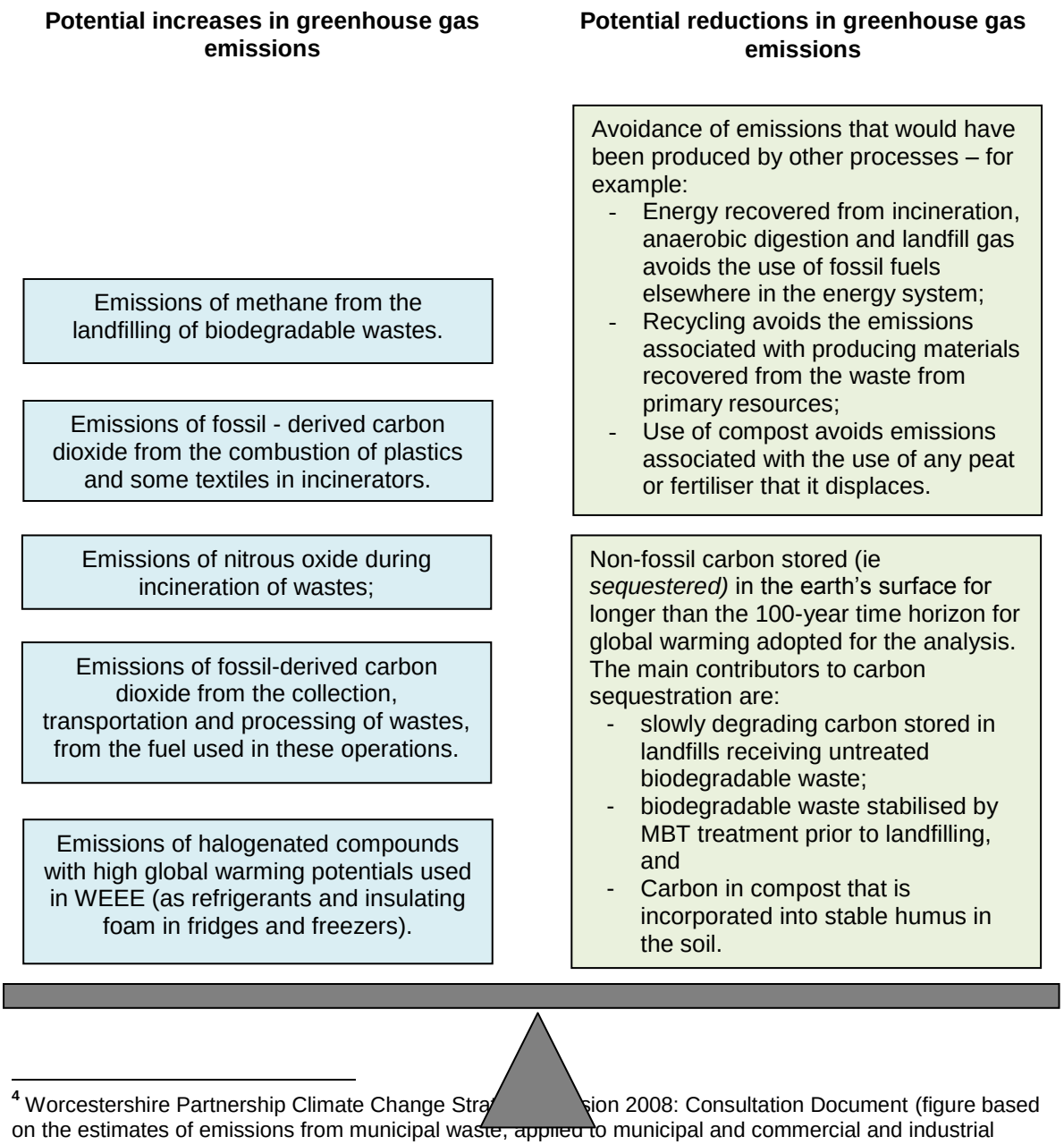
[3] Anthropogenic emissions of $CO_2$, $CH_4$ and $N_2O$ in the EU in 1994 over a 100 year horizon.

- collection and transport;
- treatment, recycling and energy recovery and
- final disposal.

Whilst many of these activities consume energy and produce greenhouse gases, others convey a greenhouse gas and energy benefit through energy recovery or materials recycling, reducing the need for virgin materials (7) . The balance of impacts and benefits can be a fine one and can vary dependent on the techniques used and the material involved (7) . Examples of these impacts and benefits are illustrated in Figure 1.

Waste management currently contributes approximately 3% of Worcestershire's greenhouse gas emissions[4].

Figure 1: Implications for Greenhouse Gas Emissions




[4] Worcestershire Partnership Climate Change Strategy Revision 2008: Consultation Document (figure based on the estimates of emissions from municipal waste, applied to municipal and commercial and industrial waste streams)

Source: Based European Commission (2001) *Waste Management Options and Climate Change* pii

## Effects of Climate Change on Waste Management

Because of the importance of waste collection and management to the economy, and the risks waste management can pose to human health and the environment, changes in climatic conditions could cause a variety of problems within Worcestershire and surrounding areas. Extreme weather conditions could severely affect unprepared facilities as well as cause harm to amenity and the environment. The impact of extreme weather events on business can be profound including direct costs, uninsured costs and business interruption and reputation loss (11). In Worcestershire severe weather events have in the past had impacts on waste management, for example in the July 2007 floods household waste sites at Hill and Moor, Tenbury, Upton upon Severn, Droitwich, Bilford road in Worcester, Stourport and Hoobrook in Kidderminster were closed temporarily. This was either due to flooding on site or because flooding on surround roads meant that vehicles were unable to reach the facilities. In addition the flooding resulted in quantities of waste that were estimated to be 2,000 tonnes higher in July 2007 than if no flooding had occurred. It was also estimated to be higher than usual in the following months as the clear-up continued (7).

A report commissioned by the Environment Agency (12) highlights the fact that waste management facilities are often in place for decades, a similar time scale for climate change effects to be felt, therefore waste management facilities and operations could themselves be affected by climate change; particularly landfill sites that are still active in-situ years after operations have ceased (11). In addition the planning and development of waste management facilities requires long term investment and the difficulties experienced in site selection, planning and development are likely to determine that, once approved, sites will retain a waste management use for many years (12).

The more general impacts of climate change are considered in *Planning for Climate Change in Worcestershire* but changing weather conditions are also expected to have a number of impacts on waste management facilities more specifically. Different kinds of facilities will be particularly susceptible to different aspects of climate change but these impacts might include (12):

- Increased precipitation which could increase flooding on site and in the surrounding area from surface water, ground water and drainage systems. This might affect on-site facilities such as weighbridges and gas and leachate production, composition and control.
- Changes in moisture levels, site hydrology and temperature which could affect waste degradation rates, leachate production and composition;
- Increased precipitation which could increase flooding in areas surrounding the site, causing disruption to supporting transport infrastructure and hence the delivery of waste;
- Increased risk of subsidence and slope instability from drying out of soils followed by rapid wetting due to heavy rainfall;
- Inundation and/or erosion of low lying riverside facilities;
- Increased health risk to workers from increased sunshine exposure to UV radiation and increased pathogen and vermin activity;

- Changes to the types and amount of flora and fauna that can live on and around facilities and the choice of ecological communities used to restore landfill sites.

The Council's Technical Research Paper *Planning for Climate Change in Worcestershire* and in the Worcestershire Partnerships *Climate Change Strategy* provide further information on adaptation and understanding climate change impacts in the County, this document will focus on those elements most relevant to waste management facilities.

# The approach towards addressing climate change

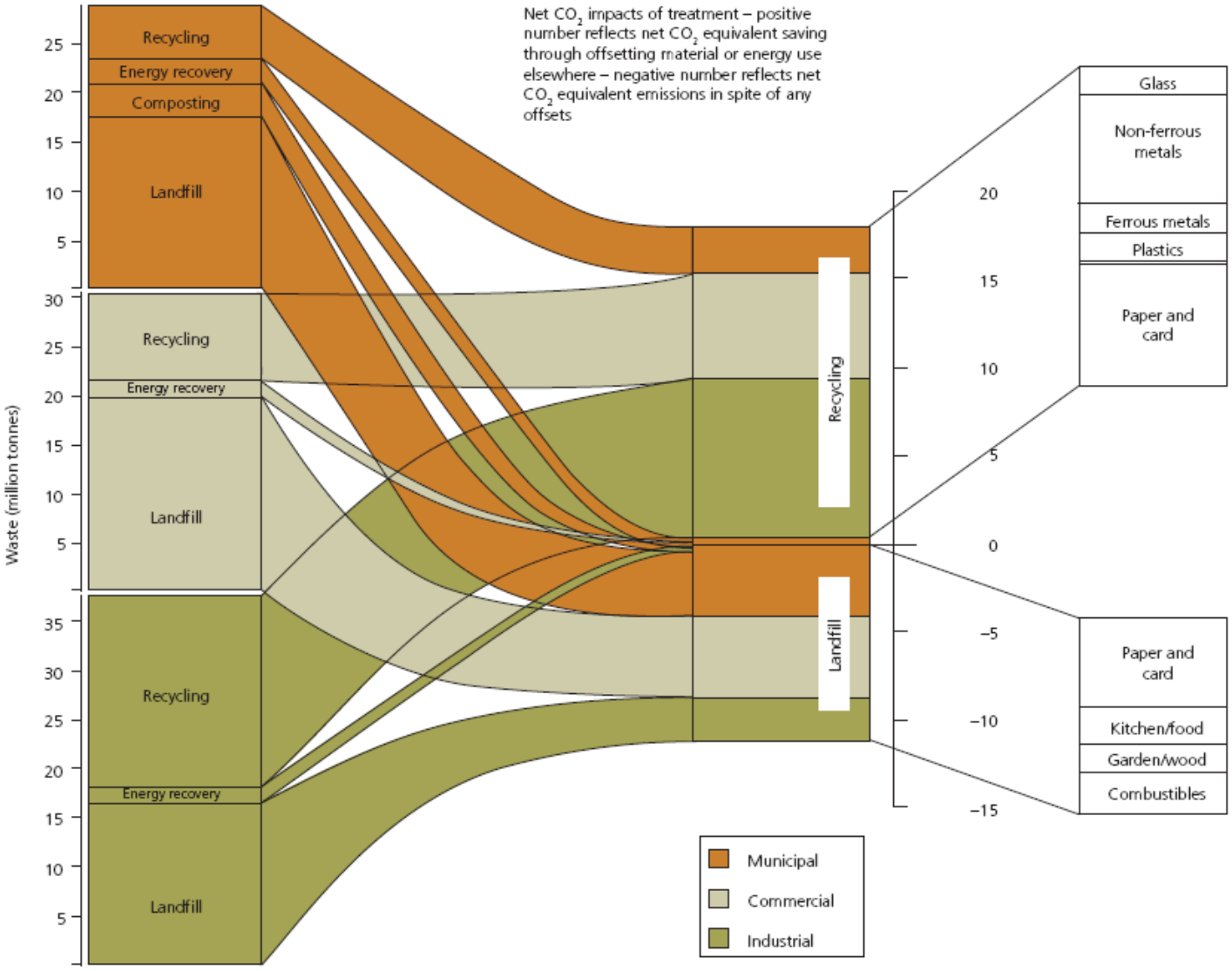
The challenge of climate change will need to be addressed via a holistic approach that includes (13):

1. Reducing/Mitigating emissions of greenhouse gases, in particular $CO_2$ in line with national and regional targets;
2. Adapting to the effects of climate change, particularly in those areas vulnerable to it effects, recognising that emissions into the climate already are having an effect i.e. designing in resilience to effects of climate change beyond that of the plan period and being prepared to revise plans and strategies as evidence as to the impacts of climate change becomes available;
3. Taking action to understand the impacts and risks of climate change will improve resilience and reduce the cost of adapting to future changes in the climate;
4. Capitalizing on the opportunities presented by a changing climate;
5. Taking a precautionary approach (seeking a no regrets solution) towards climate change but not placing unnecessary burdens on the development industry;
6. Considering obstacles that may arise such as: a perceived uncertainty of climate change; and lack of consensus, awareness and political will; resource constraints, no easy answers; and the public opposition to projects such as renewable energy schemes; as well as the need to bring about behaviour change.

# The climate change impacts of waste management

Different waste management facilities have different potential climate change impacts, however there are many variables involved. These include the techniques used and types of waste stream treated.

**Figure 2: Greenhouse gas emissions from the main waste sectors**




Source: Defra *Waste Strategy for England 2007*

Figure 2 summarises the climate change impacts of landfill, incineration and recycling. On the left the 100 million tonnes of waste produced annually in England are broken into the three main sectors, illustrating how much is landfilled, incinerated or recycled. On the right are the net greenhouse gas impacts (in carbon dioxide equivalents). The bottom right of the diagram shows that landfilling has significant negative impacts. On the other hand, recycling of materials saves the energy and

emissions that would otherwise be required to extract raw materials. The positive impact is shown on the top right. Energy recovery from thermal treatment options, or composting of biodegradable materials avoid the negative effects of landfilling (methane emissions) and save limited amounts of energy or materials and therefore have a small positive affect overall. These treatment options are considered in more detail below.

## *Recycling*

The climate change benefits of recycling compared to manufacture from virgin materials are now widely appreciated. In general, energy is required to convert waste materials into secondary products. However, this is typically less than the energy required to make the primary materials they displace, so net benefits accrue (7).

It is thought that the UK's current recycling of glass, paper and cardboard, plastics, aluminium and steel materials saves between 10-15 million tonnes of $CO_2$equiv per year compared to applying the current mix of landfill and incineration with energy recovery to the same materials. This is equivalent to about 10% of the annual $CO_2$ emissions from the transport sector, and equates to taking 3.5 million cars off UK roads (14). However the benefits depend upon the type of material considered.

Whilst some materials, such as metals can be recycled indefinitely with impacting on quality, others such as paper can only be recycled a limited number of times.

## *Energy Recovery*

Energy can be recovered from waste through biological or thermal technologies.

The purpose of thermal treatment of waste is to reduce the bulk of waste needing ultimate disposal in landfills to an inert inorganic ash residue (3). This residue is stabilised and would therefore not produce landfill gas. Methods of treating waste by combustion include incineration with energy recovery (Energy from Waste (EfW)), gasification and pyrolysis. Each of these has the capability of thermally degrading waste and recovering energy, as electricity and/or heat. Any energy recovered in the process can be used to generate electricity exported to the national grid, or used for localised heating systems, and displaces the production energy or heat from other sources (15). Incineration of waste emits carbon dioxide and small amounts of nitrous oxide; however the levels of greenhouse gases resulting from incineration depend heavily on the material in question.

Anaerobic digestion (AD) is an biological technology for recovering energy from biodegradable organic waste. The digestion recovers energy from organic materials as a result of degradation in the absence of oxygen and the production of 'biogas' (methane and carbon dioxide) through biological activity. This gas is typically 55-65% methane, with the remaining being $CO_2$. It can be combusted to generate electricity and/or heat, and thereby displace fossil energy sources. Most of the methane is converted into $CO_2$ during combustion. The waste is converted into a digestate, which can be in either liquid or solid form, can be used as a soil improver, with an associated fertiliser benefit (7).

In the UK we produce over 100 million tonnes of organic material every year. It is thought that through AD this could be used to create enough energy to heat and power over two million homes (17).

As such the main benefits from composting and AD are from avoided energy and materials use, including benefits due to the reduced need for mineral fertilisers (3).

Whilst energy from waste plants are not considered to provide a form of "renewable energy" (16), they can be preferable to disposing of the waste to landfill as they can be used to avoid creating emissions from energy production elsewhere. The avoided emissions from incineration vary considerably dependent on the material and on the emissions they are considered to replace.

## *Composting*

Composting is a natural biological process by which bacteria, fungi and insects break down organic matter in the presence of air. Composting takes place either as “open windrow” or “in-vessel”.

Composting biodegradable waste has advantages over landfill as the waste is broken down in the presence of air, avoiding methane emissions which result when biodegradable waste breaks down in the absence of oxygen (methane is 23 times more potent a greenhouse gas than carbon dioxide). Composting only uses low levels of energy in the processing of waste and a relatively small additional benefit comes from carbon sequestration due to the storage of carbon in soil following the use of compost in agriculture (3).

The composting of organic matter converts about half of the carbon content of the waste into $CO_2$. If the resulting compost product is spread on the land. It is estimated that about 92% will be converted into $CO_2$ overtime and 8% will have been sequestered (3). In the case of putrescible waste, this equates to some 22 kg $CO_2$equiv/tonne of waste (3).

When the end product is used as a soil improver, it can replace the use of peat. UK soil stores about 10 billion tonnes of carbon in the form of organic matter, with over half of this being stored within peat habitats. A 1% loss of soil carbon would be equivalent to the UK’s annual fossil fuel emissions; protecting this carbon store is therefore a priority (18) . When the peat is extracted or used as a growing medium or soil conditioner it mineralises rapidly, releasing carbon as $CO_2$. Each cubic metre of peat replaced by compost will save the emission of about 247 kg of $CO_2$ (3).

The potential for use on compost as a soil improver is however limited (as is the use of digestate from AD) due to the potential for the deposition of heavy metals, the potential impacts of diffuse pollution and limits on the quantity which can be spread is on land[5]. This is a particularly issue in nitrate vulnerable zones where regulations allow for a maximum of 250kg/ha nitrate from organic sources, including compost, to be spread on all fields in a 12 month period (19). (This is equivalent to about 28 tonnes of compost/ha (19)). Some compost does not meet the standards required for use as a soil improver and is instead used as a daily cover for landfill, or sent to landfill for disposal, however this waste will have been stabilised through the composting process, minimising impacts from landfilling the waste.

[5] Defra has been carrying out a programme of research to better understand the risk of soil pollution (18).

## *Landfill*

*Landfill* is defined as a waste disposal site for the deposit of waste into or onto land (20).

Landfill sites can contribute significantly to UK greenhouse gas emissions through the uncontrolled release of landfill gas. Landfill gas results from the degradation of the organic/biodegradable portion of waste. The typical depth of the waste in landfill means that any oxygen within the waste is used up more quickly than it can diffuse in from the air. This results in anaerobic conditions, under which the waste degrades to produce landfill gas. This contains roughly 50% methane and 50% carbon dioxide (3) (although the methane content can vary from about 45-65% (13)). In sites with no gas control, the gas migrates along the path of least resistance, this often means it migrates to the surface of the landfill site and is released. As such, landfill sites are responsible for approximately 40% of the UK's methane emissions (21).

The composition of the waste can have a significant impact in the speed of landfill gas release and the quantities involved; for example newspaper and textiles degrade more slowly than paper, card and food wastes; green wastes degrade much more quickly (7). In the past food and garden wastes were considered to be the major source of landfill gas, however they typically contain 70% water. The most significant source of emissions is instead from paper and card (7). Plastic wastes on the other hand are inert in landfills and so do not contribute to emission levels (3) . As the biodegradable content of the landfill waste is reduced (as a result of the Landfill Directive) so the volumes of gas will reduce.

In sites with gas control, a low permeability cover prevents gas release and a system of wells and pumps is used to extract the gas. The collected gas is either flared or combusted for energy recovery and is converted to carbon dioxide. Uncollected gas migrates through the cover. Some gas may also escape through cracks or imperfections in the surface layers and from around the edge of the landfill (3).


Landfill gas collection at Hill and Moor landfill site, near Pershore, Worcestershire

Where gas is collected and burned in a gas engine to produce electricity or flared the production of greenhouse gas is considerably reduced and energy can be recovered from the waste (7). The current permitting regime expects 85% of landfill gas to be collected during the period when gas management is practicable (7), however there are periods at the start and end of a landfill's life during which gas collection is technologically impractical.

Landfill gas systems are in place in 90% of UK landfill sites (3) and an estimated 5% of the total renewable energy produced in the West Midlands is from landfill gas at the Hill and Moor landfill site in Worcestershire (13). Landfill methane emissions are

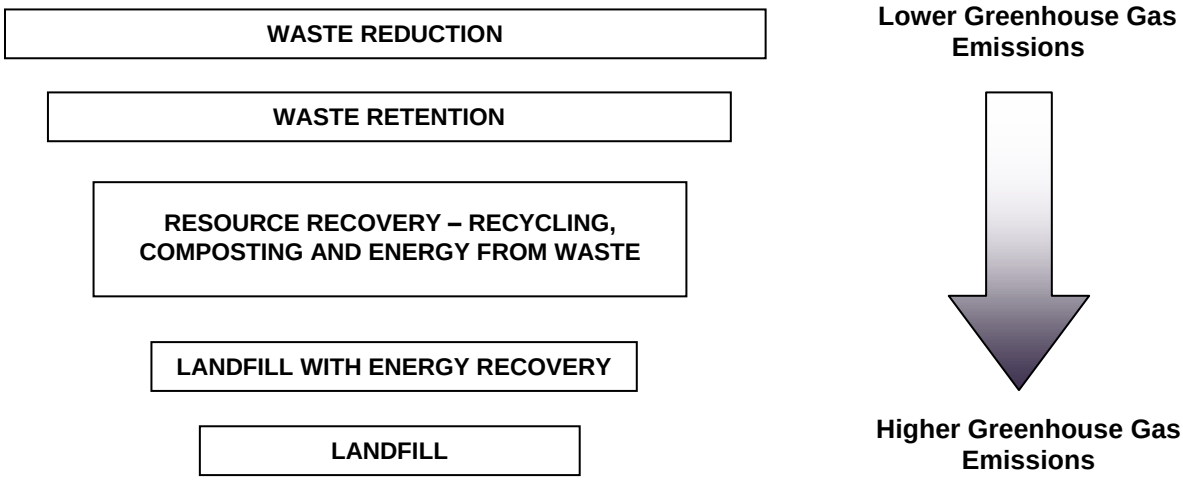
expected to be around 70% lower in 2010 than 1990, as a result of measures to collect and burn landfill gas and reduced waste disposal in landfill (22). The energy provision from landfill gas is very site specific and depends on the material involved.

The EU Landfill Directive has introduced targets for reducing biodegradable waste disposed of to landfills to 75% of 1995 levels by 2010, reducing to 50% and 35% by 2013 and 2020. The directive also requires improvements in environmental standards of landfills, in particular by requiring greater use of landfill gas collection and energy recovery in order to reduce the main greenhouse gas impact of this waste management option (3).

# Considering the options

It is clear that each waste management technique has a different impact on greenhouse gas emissions. These impacts depend on a number of factors including the composition of the waste stream and a number of site specific factors. Where management involves the recovery of energy or resources from the waste any comparisons also depend on a set of assumptions about the source of the energy which is being 'replaced' and the benefits of using recycled rather than virgin materials. It is however clear that for many materials recycling has significant greenhouse gas benefits in comparison to disposing of them to landfill. The benefits and overall merits of each approach tend to accord generally with the waste hierarchy, as shown in Figure 3:

**Figure 3: Waste Hierarchy and Climate change impacts**




Concentrating on the upper end of the hierarchy could help to mitigate climate change impacts, however a variety of facilities are required to effectively manage Worcestershire's waste and it is the intention of the Waste Core Strategy to allow for different types of facilities. It will however not actively seek to allocate sites for landfill and could include a requirement for all landfill sites accepting non-inert waste to contribute to reducing greenhouse gas emissions by requiring landfill gas collection and management systems and where possible generate electricity.

There are however a range of other elements which could be considered with regard to mitigation and adaptation.

# Mitigation and Adaptation

There are two aspects of climate change that need to be considered by prospective developers of new waste facilities:

- How the proposals impact upon the process of climate change through carbon emissions and resource use (mitigation);
- How the development may be affected in the future as a consequence of the effects of climate change (adaptation).

Mitigation and adaptation should not be considered independently of each other, and new development should be planned with both in mind; so whilst this document addresses each in turn for the purpose of clarity, each element should be considered to form part of an integrated approach.

Planning Policy Statement 1: Delivering Sustainable Development (PPS 1) states that:

> *"local planning authorities should ensure that development plans contribute to global sustainability by addressing the causes and potential impacts of climate change – through policies which reduce energy use, reduce emissions…promote the development of renewable energy resources, and take climate change impacts into account in the location and design of development."*(1)

The supplement to Planning Policy Statement 1 develops this further:

> *"The proposed provision for new development, its spatial distribution, location and design should be planned to limit carbon dioxide emissions."*(2)

The following section will considers these themes.

# Spatial distribution and location

Careful consideration of site location can have a role in the mitigation; for example, through location of waste sites either close to the source of arisings or close to other sites in the same onward chain it may be possible to reduce waste miles and transport impacts. An understanding of climate change impacts is also important when selecting sites, as this can help to improve resilience and reduce the costs of adaptation.

## Mitigation Measures

The main consideration relating to site location and mitigation measures is transport. It has been suggested that the typical distances travelled by wastes are as follows (23):

- *Residual waste collections*: 1.5 km per tonne
- *Recycling collections*: 2 km per tonne
- *Transport to recovery/composting/landfill*: 30 km per tonne
- *Transport to reprocessors/recyclers*: 100 km per tonne

Emissions from transport are a locally important issue, with a reduction being one of the priorities set out in the Worcestershire Climate Change Strategy and nationally

the transport sector has a key role in reducing $CO_2$ emissions. Transport related emissions in the UK were 14% higher in 2005 than in 1990 (24), with increased vehicle kilometres being the main reason for this (25).

Locating waste sites either close to the source of arisings or close to other sites in the same onward chain could be one way to reduce waste miles and transport impacts. Bulking stations and waste transfer stations/MRFs can also have an important role to play in minimising waste miles per tonne, especially when located in close to the waste source. Proximity to source is also likely to have an impact on household waste sites and other sites which rely on ease of public access, with proximity (rather than market) likely to be predominant factor influencing travel distances.

However transport emissions make up only a small component of the greenhouse gas impacts from waste management (3) in comparison to the emissions related to the waste management activities themselves and the avoided energy/materials, landfill gas emissions and carbon sequestration which result from some waste management activities. Variations in emissions due to alternative transport routes and modalities are therefore thought to have a negligible impact on the overall greenhouse gas impacts of the waste management options (3). For example studies suggest that there are $CO_2$ savings to be made from recycling plastic bottles and paper, even if the recovered materials have to be transported to China for processing (26).

Planning has a clear role to play in its allocation of land uses but meetings with operators in the waste industry in Worcestershire have shown that the market also has an often under estimated role, with cost effectiveness rather than proximity dictating many of the decisions made. One symptom of this is the increase in exports of recovered material, with recovered paper increasing from 400,000 tonnes in 1998 to around 4.7 million tonnes in 2007. Similarly, exports of recovered plastics increased from less than 40,000 tonnes to over half a million tonnes over the same period (26). The principal export destination of materials for recycling is China, which accounts for more than half of the UK's exports of recovered paper and more than 80% of recovered plastics exports (26). Studies suggest that there are $CO_2$ savings to be made from recycling plastic bottles and paper, even if the recovered materials have to be transported to China (26).

Although the majority of studies appear to agree that impact of transportation of waste are negligible, compared to the impacts of overall waste management activities. There are exceptions; namely the transport of soil and mineral materials such as those derived predominantly from construction and demolition activities (7). Due to the bulk and weight of these wastes transport distance are a more significant factor than for other waste streams, with transport emissions per km per tonne being greater.

## *Possible development of policies: Mitigation*

Whilst transport emissions are only a small component of the greenhouse gas impacts of waste management, greenhouse gas emissions from transport are a locally and nationally important issue and a reduction is one of the priorities set out in the Worcestershire climate change strategy. The Waste Core Strategy could therefore aim to reduce waste miles, traffic movement and transport impacts as much

as possible, whilst being mindful that due to market influence, the nearest facilities will not always be the ones that are used.

The location of bring sites and other household waste sites on the other hand depends on the ease of access by the public. Transport could therefore be a significant consideration in these cases, with location close to areas of towns and cities helping to minimise travel distances of members of the public who wish to use the sites. The potential use of alternative modes of transport could be considered but this is likely to be limited where sites are used to deposit bulky items.

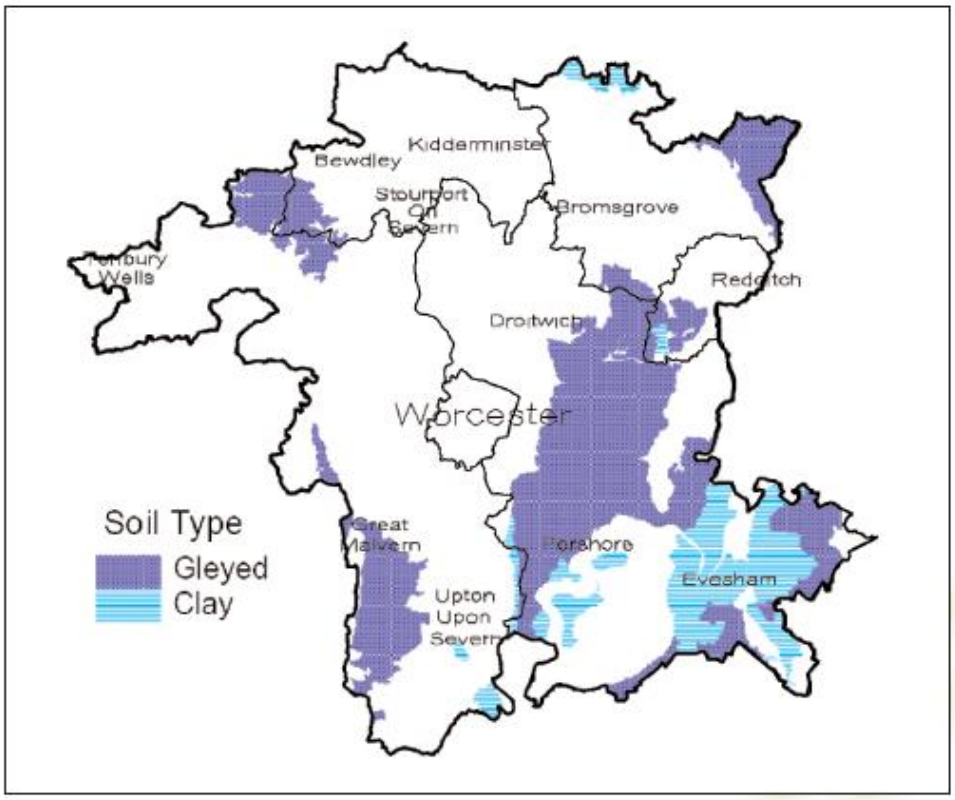
Due to the bulk and weight of the materials involved, transport is likely to be a more significant factor in relation to construction and demolition waste than other waste streams. It may therefore be useful to consider the co-location of compatible minerals and waste facilities which deal with soils and construction wastes in order to maximise use of 'reverse logistics', bulking and transfer for the movement of material. On-site processing on construction and demolition waste, including crushing and screening may also serve a useful role in minimising waste miles through the reuse of materials in situ.

## Adaptation Measures

The impacts of climate change are likely to vary and the county will become increasingly at risk from extremes of weather and physical changes. The ability of the county and its communities to adapt will vary depending on local geographical, environmental and climatic factors. The maps below illustrate areas at risk from a series of physical and environmental factors (13):

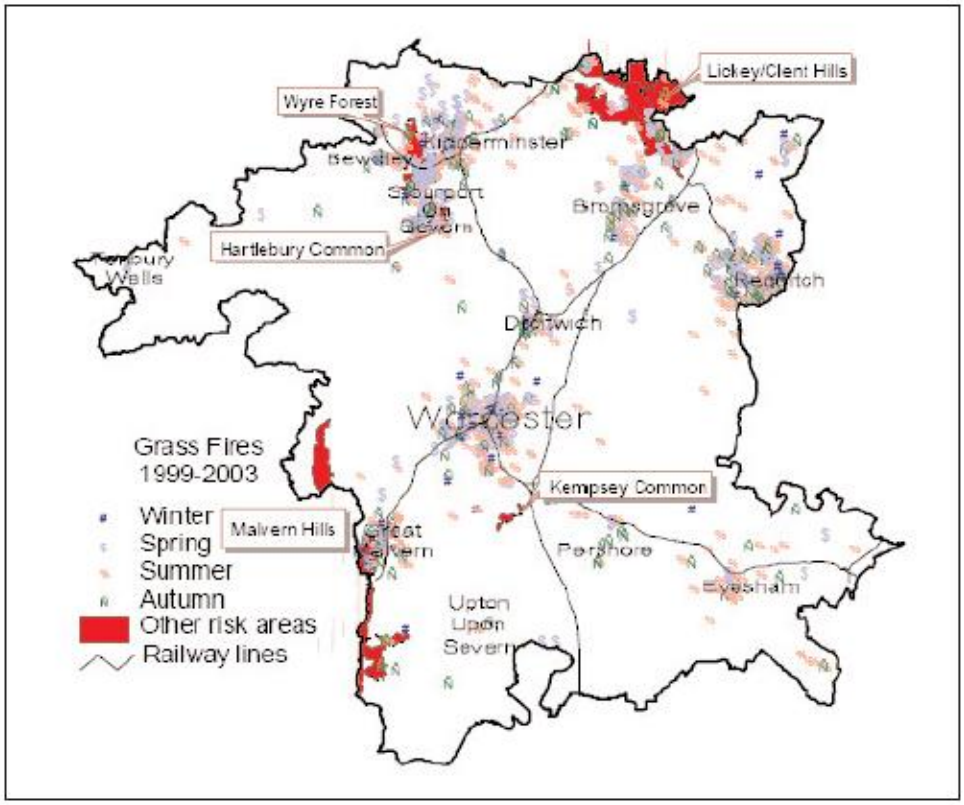
- Subsidence - as a result of the shrinking and heaving of clay soils (Figure 4)
- Fires - as a result of periods of prolonged dryness and extremes of temperature (Figure 5).
- Flood - from increased winter rainfall and periods of sudden intense rainfall (Figure 6).

**Figure 4: Map of increased risk of subsidence in Worcestershire**



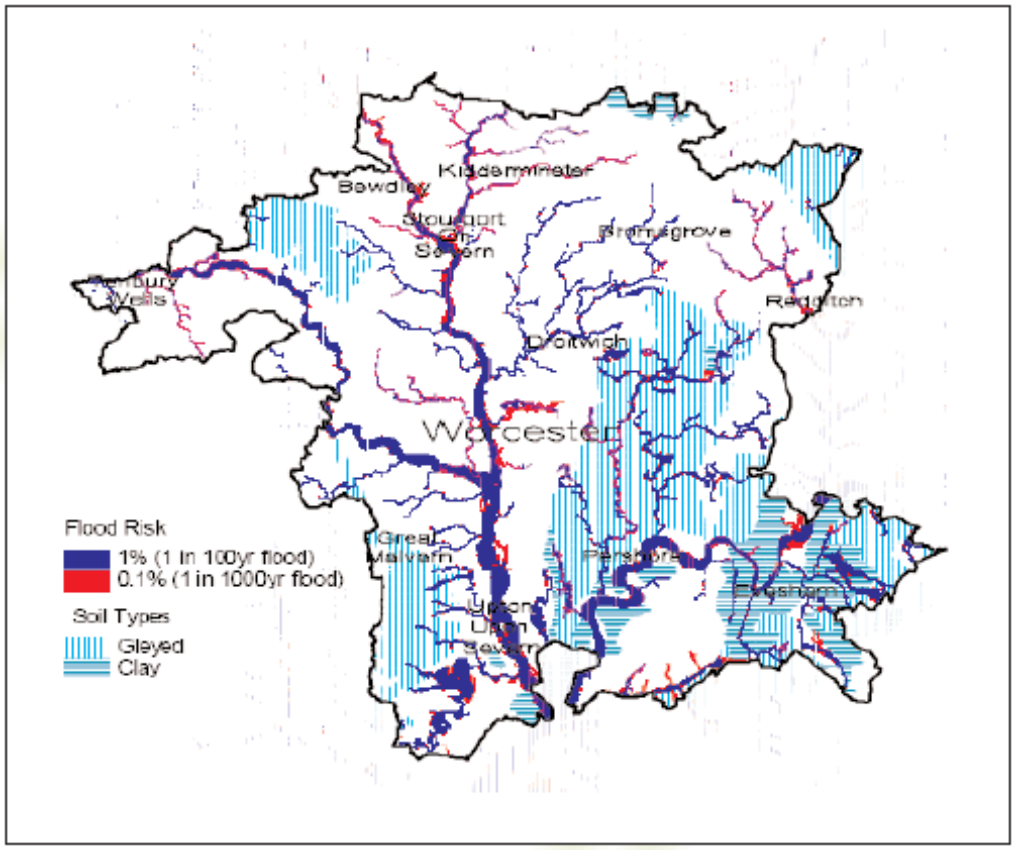

Source: Worcestershire Climate Change Impacts Study

**Figure 5: Map of areas at risk from outdoor fires in Worcestershire**




Source: Worcestershire Climate Change Impacts Study

**Figure 6: Map of areas at risk of flooding in Worcestershire**




Source: Worcestershire Climate Change Impacts Study

### *Possible Development of Policies: Adaptation*

Some of these elements, such as flood risk are required to be assessed by national policy (Planning Policy Statement 25), however the Waste Core Strategy could make provision to consider the risk the physical and environmental factors listed above and any others which may be relevant.

# Design

A recent report for Defra identifies a number of guiding principles for achieving sustainable design in the waste sector (27):

- resource efficiency;
- energy efficiency;
- pollution prevention;
- harmonisation with the environment, including environmental mitigation
- integrated and systemic approaches, for example an environmental management system.

Several of these are relevant to climate change and reductions in greenhouse gas emissions, either directly through reduced energy consumption or through the reduced requirement of virgin materials. Climate sensitive design will need to be holistic in its approach; for example adapted to a hotter climate yet not creating extra energy demands through use of air conditioning (13).

## Mitigation

The energy used in constructing, occupying and operating buildings represents approximately 50% of greenhouse gas emissions in the UK (28), with energy efficiency having a significant influence on this. A building's energy efficiency is determined by a number of factors, but key to this are the issues of design and the materials used in construction. In tackling climate change it is imperative that all new buildings are designed to high-energy efficiency standards as well as having regard to issues of their energy source, accessibility of their location to essential services and green infrastructure (13).

The Defra guidance recommends that design should involve considering the entire life cycle of buildings, taking environmental and functional qualities into account, whilst considering the easy decommissioning of the site and reuse of the building or recycling of building fabric for its composite materials (27), in some cases this could include the consideration of site restoration. Other considerations could include the role of site layout and landscaping proposals.

In the 2008 budget the government announced ambitions for all non-domestic buildings to be zero-carbon by 2019, however it is currently difficult to define "zero-carbon", with the term being defined differently by different bodies.

*Building A Greener Future* (July 2007) (29) stated that when considering new homes the following aspects should be taken into account:

- emissions from space heating, ventilation, hot water and fixed lighting
- expected energy use from appliances
- exports and imports of energy from the development (and directly connected energy installations) to and from centralised energy networks, the building will have net zero carbon emissions over the course of a year.

A current consultation on the *Definition of Zero-Carbon Homes and Non-Domestic Buildings* suggests that a similar approach will be adopted for non-domestic buildings (32).

It also gives some indications of the average emission rates for buildings that meet the 2006 Building regulations. These are included in Table 1.

**Table 1: Average emission rates for buildings which meet 2006 Building Regulations**

| $kgCO_2/m^2/pa$ | Heating | Cooling | Auxiliary | Lighting | Domestic hot water | Equip-ment | All end uses |
|---|---|---|---|---|---|---|---|
| Commercial Offices | 20 | 6 | 4 | 20 | 3 | 26 | 78 |
| Communications and Transport | 16 | 12 | 5 | 22 | 4 | 28 | 87 |
| Education | 10 | 0 | 2 | 15 | 6 | 15 | 48 |
| Government | 20 | 6 | 4 | 20 | 3 | 26 | 78 |
| Health | 17 | 0 | 12 | 27 | 9 | 62 | 127 |
| Hotel | 12 | 0 | 4 | 14 | 27 | 13 | 70 |
| Retail | 11 | 49 | 8 | 68 | 0 | 13 | 150 |
| Sports and Leisure | 0 | 30 | 15 | 22 | 31 | 14 | 112 |
| Warehouses | 17 | 0 | 0 | 4 | 0 | 5 | 26 |
| Other services | 13 | 10 | 7 | 27 | 9 | 31 | 97 |
| Industrial | 1 | 0 | 15 | 52 | 0 | 0 | 69 |
| Average all sectors | 12 | 8 | 7 | 28 | 5 | 16 | 76 |

Source: Communities and Local Government (2008) *Definition of Zero-Carbon Homes and Non-Domestic Buildings: Consultation*

Waste is not considered explicitly but for the purposes of this document the similarity between many indoor waste activities, such as waste transfer stations/MRFs, and industrial operations could be drawn. Many waste management facilities, such as recycling operations or those with elements of energy recovery may be part of a process which reduces greenhouse gas emissions from waste management and the use of primary materials, therefore any calculations of zero-carbon are likely to be even more complex and potentially misleading.

An alternative approach could be to consider BREEAM Standards for Industrial Buildings. The BREEAM assessment considers a range of themes, including $CO_2$ emissions, energy and water efficiency, public transport, building materials, landscaping and pollution and ecology impacts. Buildings are scored against a set of criteria and then rated from Pass - Excellent. This gives the opportunity to consider a wider range of measures in an integrated manner and would integrate many of the considerations outlined and could allow greater flexibility for innovation. The waste core strategy could require any development involving a new building to meet BREEAM *Very Good* standards. This would integrate many of the considerations outlined and allow greater flexibility for innovation, however national policy requires planning authorities to set a target percentage of the energy to be used in new development to come from decentralised and renewable or low-carbon energy sources where it is viable. In addition Draft policy SR3C in the Phase 2 Draft Preferred Options of the WMRSS includes a policy that all new medium and large scale development should:

> *"incorporate renewable or low energy equipment to meet at least 10% of the development's residual energy demand".*

It is likely that the proposed RSS policy or something similar will be approved by the Secretary of State. The Waste Core Strategy should therefore follow this approach.

In addition the Waste Core Strategy could pay attention to several different elements of design which could have a role in reducing emissions:

- **Energy Efficiency and Supply:** Sustainable energy use could be encouraged in a number of ways, for example orientating buildings to maximise use of sun light and utilising heat or energy produced through waste management processes. Other factors, such as orienting rooflights to maximise the use of sunlight or incorporating solar water heating or photovoltaics may be relevant (27).

  With regard to supply, new development could be required to gain a minimum proportion of their supply from renewable or low-carbon source. However a recent report suggests that Worcestershire, relative to other UK Counties, is limited in its renewable energy resources, with it being estimated that the overall potential for renewable generation equates to approximately 3.7% of current (2006) overall energy demand of the County and 3.5% of an estimated energy demand in 2020 (30). In this report the most significant resource in terms of electrical generation is identified as wind power, but it concludes that compared to other counties in the UK, Worcestershire's wind resource is relatively low, with the exception of localised areas of reasonable wind resource (30). Hydropower was found to have limited potential in the Worcestershire and the potential of biomass as a resource was considered extremely complex and difficult to calculate, but was in any case expected to be low (30). The report does not consider energy from waste.

  The waste core strategy could encourage energy generation from waste and allow for the provision of small scale sites for anaerobic digestion in order to contribute towards the national aspiration for decentralised, renewable/low-carbon energy. These facilities are likely to be community-based sites, small scale on farm facilities (particular in rural off-grid locations) or on new developments such as business parks.

  The strategy could remain mindful that in the short-term, financial viability and availability of material may limit the development of such sites, however in the long-term this may not form a barrier.

- **Construction Methods:** The building dimensions and materials used in its construction will be a significant factor in determining the energy usage requirements of a facility (27). Construction materials could minimise the use of virgin materials and maximises the use of recycled/reused materials. The choice of materials used in construction will affect energy efficiency. For example, using a dark coloured roof cladding in a hot climate will be less energy efficient than choosing a light coloured or reflective finish (27).

- **Landscaping and Restoration Proposals:** Landscaping elements are often involved in a range of waste development proposals. Schemes could utilise trees to provide solar shading. In addition the use of native species could contribute towards an integrated multifunctional green infrastructure in which employment and industrial sites will need to consider linking habitats, biodiversity and sustainable transport routes for employees and others. This would also have a number of adaptation benefits, including contributions to urban cooling and the conservation and enhancement of biodiversity, whilst recognising that the distribution of habitat and species will be affected by climate change.

It is standard practice for planning proposals for landfill sites to include restoration schemes. Restoration of these sites could have a role in climate amelioration, for example through the development of carbon sinks, connectivity habitats or on some sites flood attenuation, again a recognition that the distribution of habitat and species will be affected by climate change will be key.

### *Possible Development of Policies: Mitigation*

The Waste Core Strategy could require energy management, environmental performance and carbon reduction to be determining factors in the design of new waste management facilities. This could include an emphasis on construction methods which maximise the use of recycled/reused materials.

Policies could be developed which require developments over a certain size to gain a minimum proportion of their supply from renewable or low-carbon source, unless they are part of a process which itself reduces greenhouse gas emissions. This would be consistent with the RSS, however it should be remembered that the potential for local or decentralised energy may be limited in Worcestershire.

The Core Strategy could encourage energy generation from waste and developments that enable the replacement of fossil fuels.

Landscaping of facilities could have regard to enhancing, linking and extending natural habitats so that biodiversity can adapt to climate change and hence help to mitigate its effects by reducing 'heat islands', acting as carbon 'sinks', absorbing flood water. Any restoration requirements could be made with climate amelioration in mind and could also make allowances for climatic changes which may impact upon biodiversity on a site.

## Adaptation

There are several documents considering sustainable design, the key recommendations felt to be relevant to waste facilities are listed below:

- Climate change may alter average seasonal temperatures, which may lead to an increase in the amount of energy used for the heating and cooling of buildings. In order to minimise climate change impacts and contribute to emission reductions design of facilities could maximise heat gain and loss through the use of passive building principles, such as solar orientation (13), the use of building materials and the consideration of the internal layout (27).

- Extreme weather such as flooding events are more likely to occur in the future. To minimise risk site should be selected, and layout designed, with regard to proximity to water courses (27). Facilities will need a drainage system that can cope with high levels of rainfall and improved attenuation of runoff. The incorporation of sustainable urban drainage systems (SUDS) such as green roofs and permeable car parks, may also present a solution (27).

- The wetting and drying effect on soil may cause subsidence issues, potentially affecting the structure of a building as rainfall and temperature increases. This can be particularly true for areas with clay soils. To reduce this risk, developers may need to carry out suitable investigations to determine soil

type and provide deeper foundations or piling to avoid subsidence issues where particular soils cannot be avoided (27).

- Higher wind speeds may increase the structural design parameters of stacks and other high structures, while periods of intense driving rain may cause water to infiltrate the building. It is also important to consider suitability of construction materials in excessive temperatures as some may blister, warp or soften (27).

- Seasonal temperature variations and precipitation may impact on decomposition rates of waste and as such the processes involved in some waste treatment methods may need to be revised to reflect this(12).

### *Possible Development of Policies: Adaptation*

The Waste Core Strategy could require potential climate change impacts and adaptation to be considered in the design of new waste management facilities. This could include the elements outlined above. Advice on the implementation of these requirements would have to be provided, with further guidance available prior to any application where relevant.

## Monitoring

The positive or negative contribution of the Waste Core Strategy to the Local Area Agreement Targets (set out in Appendix 3) could be monitored in the Annual Monitoring Report. Any future locally relevant targets could also be monitored in this way as the need arises.

# Conclusions

Waste management contributes significantly to local greenhouse gas emissions. In order to fully contribute to local and national reduction targets the Waste Core Strategy could seek to mitigate climate change impacts, through securing high energy efficiency and reduction in emissions. Adaptation could be considered in relation to site location and building design by focusing development in areas with least risk and by considering the specific needs of individual operations.

# Appendix 1: Policy Context

## International

**Kyoto Protocol**
The UK has a legally binding target under the Kyoto Protocol to reduce emissions of a basket of six greenhouse gases (carbon dioxide, methane, nitrous oxide, hydro fluorocarbons, per fluorocarbons and sulphur hexafluoride) to 12.5% below base year levels over the commitment period from 2008 to 2012.

**EU Landfill directive**
Article 5 of the Directive progressively limits the quantity of biodegradable municipal waste that can be landfilled, with the aim of reducing the emission of greenhouse gases and leachate. The Directive sets the following targets for reduction of biodegradable municipal waste landfilled:

- by 2010: reduce to 75% of that produced in 1995
- by 2013: reduce to 50% of that produced in 1995; and
- by 2020: reduce to 35% of that produced in 1995.

## National

**Climate Change Act (2008)**
The Climate Change Act sets a target that the UK carbon account for 2050 must be at least 80% lower than the 1990 baseline. There must be annual accounts of UK emissions of all greenhouse gases, but 'targeted' greenhouse gases such as methane and nitrous oxide are not included in the 80% reduction targets.

Part 5 of the Act refers specifically to waste reduction, with specific references to reducing domestic waste and recycling more of what is produced.

The first climate change budget announced in April 2009 committed the UK to reducing greenhouse gas emissions to 34% by 2022.

**Energy White Paper (2007)**
The White Paper sets out the Government's international and domestic energy strategy to respond to these increasing awareness of climate change and increasing need for investment in new energy infrastructure. It states that:

*"We face two long-term energy challenges:*

- *tackling climate change by reducing carbon dioxide emissions both within the UK and abroad; and*
- *ensuring secure, clean and affordable energy as we become increasingly dependent on imported fuel."*

In order to accelerate the transition to a low-carbon economy it recognises the need to:

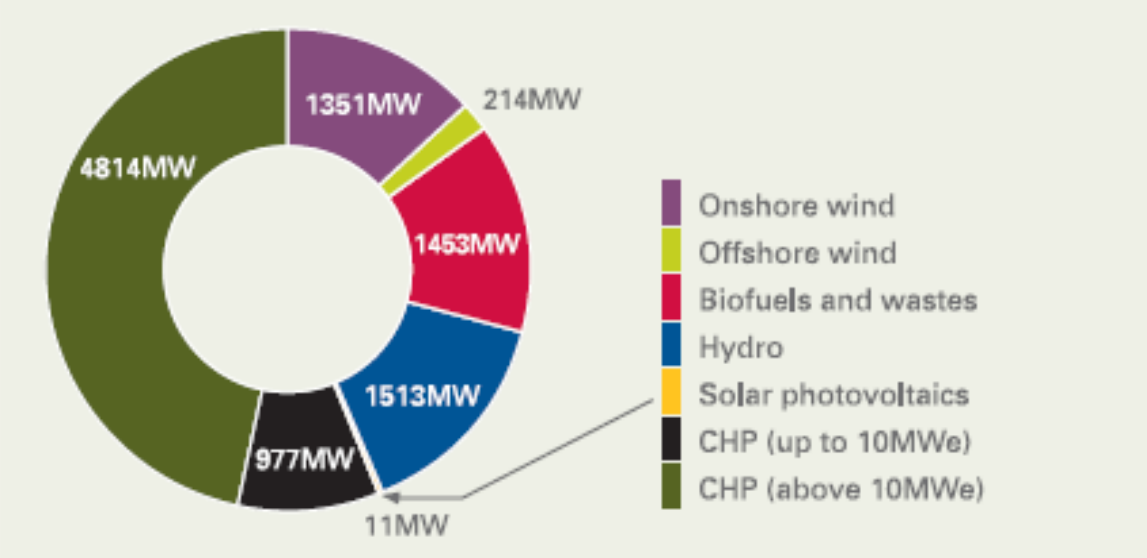
- save energy;
- develop cleaner energy supplies; and

- secure reliable energy supplies at prices set in competitive markets.

Its key targets include establishing an international framework to tackle climate change and providing legally binding carbon targets for the whole UK economy, progressively reducing emissions.

UK's electricity generation sector accounts for about one third of the UK's total carbon emissions. Over the next two decades, the UK will need substantial investment in new generation capacity to replace the closing coal, oil and nuclear power stations, and to meet expected increases in electricity demand. The contribution of bio fuels is 1453MW, as shown in Figure 7; this category includes generation from landfill gas.

**Figure 7: Current Capacity of CHP and Renewable Generation**




*Source: DTI, DUKES 2006*
Note: Data is not separately collected for Distributed Generation, so this chart covers all CHP and renewable generation. In practice some of the CHP will be connected to the transmission network and some of the renewable generation (particularly wind) will generate electricity that is not used locally.

The White Paper proposes changes to the Renewables Obligation (RO), which are thought to boost support for renewable Combined Heat and Power (CHP), including the recovery of energy from waste and some types of micro generation technologies. The RO has been successful in stimulating investment in renewable energy projects. It does this by placing an Obligation on licensed electricity suppliers to source an increasing proportion of their electricity sales from renewable sources or to pay a penalty (the buy-out price). The Government remains committed to its existing decisions on Obligation levels and to retaining the Obligation until 2027 and will raise obligations to up to 20%.

**Waste Strategy for England (2007)**
The reduction of greenhouse gases is one of the main rationales behind the strategy, and climate change is seen as the most crucial threat from exceeding environmental limits. The Government's key objectives are to decouple economic growth from growth in waste by encouraging prevention and re-use, and to divert waste from landfill.

A key objective in the Strategy is to meet and exceed the Landfill Directive diversion targets for biodegradable municipal waste. Anaerobic digestion is felt to offer climate change and energy benefits over landfilling, while composting has the potential to sequester carbon in soils and to improve soil fertility, which may confer additional climate change benefits; As such the government wishes to encourage more consideration of the use of AD both by local authorities and businesses. Energy from waste from techniques such as direct combustion (incineration), secondary recovered fuel (an output from mechanical and biological treatment processes), Pyrolysis, gasification and plasma arc heating are also encouraged.

## *Relevant Performance Indicators:*

- Carbon dioxide equivalent emissions from waste management and recycling (tonnes): This indicator is underdevelopment.
- Energy Recovery from Waste – bio fuels used to generate electricity and heat.

**Securing the Future: The UK Sustainable Development Strategy (2005)**
The Strategy sets out four priorities for UK action, these are: Sustainable Consumption and Production, Climate Change and Energy, Natural Resource Protection and Environmental Enhancement and Sustainable Communities. In addressing Climate Change and Energy, it states that there must be a change in energy use and generation, but that we must also prepare for the climate change that cannot now be avoided. The strategy aims to minimise resource consumption and to promote reuse, recycling and recovery from waste, through changes in business approaches and through work to create markets for recycled materials. In doing so it aims to break the link between economic growth and the environmental impact of waste.

## *Relevant Indicators:*

In order to measure whether the environmental impact of waste has in fact been decoupled from economic growth the strategy sets out the following indicators:

- Waste: arisings by (a) sector (b) method of disposal
- Household waste: (a) arisings (b) recycled or composted

These national indicators are reported on annually in the Council's Annual Monitoring Report.

**Climate Change the UK Programme (2006)**
The programme is designed to deliver the UK's Kyoto protocol target of reducing emissions of greenhouse gases by 12.5% by 2012 and to move the UK close to the domestic goal to reduce $CO_2$ emissions by 20% below 1910 by 2010 and 60% by 2050. The programme is set out in six broad sectors, with waste being considered across all sectors:

- **Energy supply**: Energy from waste technology is felt to offer a climate change benefit over landfill, with the role of energy from waste, including advanced technologies such as anaerobic digestion, Pyrolysis and gasification expected to increase.
  With pressure to divert biodegradable waste from landfill, there will be opportunities to increase the recovery of energy from residual, post-recycling waste. This approach is felt to provide a waste management solution, as well as a source of partially – renewable energy and an additional tool for reducing carbon emissions.

- **Business**: Considers waste management and expresses a preference for diverting waste from landfill. It recognises that all waste management activities result in greenhouse gas emissions from the transport, treatment and recovery or disposal of waste.
- **Transport**: Reference is made to bio-fuels from waste.
- **Domestic**: The main sources of other greenhouse gases from the domestic sector are methane from domestic waste disposed in landfill and hydro fluorocarbons from domestic refrigeration. Landfill methane emissions are expected to be around 70% lower in 2010 than 1990, as a result of measures to collect and burn landfill gas and reduced waste disposal in landfill. Hydro fluorocarbon emissions are expected to increase from 0.1 to 0.8 MtC from 1990 to 2010, due to their use as replacements for ozone-depleting refrigerants.
- **Agriculture, forestry and land management**: 20% of the emissions in the sector arise from animal wastes. Anaerobic digestion is seen as a way of reducing these emissions.
- **Public and local government**: Energy from waste is promoted in the public sector, with particular reference to NHS incinerators.

The second Annual Report to Parliament in 2008 estimates that greenhouse gas emissions fell by 0.5% between 2005-2006 and in 2007 were estimated to be 2% lower than 2006. Emissions from Waste Management were 59% lower in 2006 than 1990 (30) .

**Planning Policy Statement 1: Delivering Sustainable Development**

*"Local planning authorities should ensure that development plans contribute to global sustainability by addressing the causes and potential impacts of climate change – through policies which reduce energy use, reduce emissions…promote the development of renewable energy resources, and take climate change impacts into account in the location and design of development."*

As such development plan policies should take account of mitigation of the effects of and adaptation to climate change through the reduction of greenhouse gas emissions and the use of renewable energy. In addition waste reduction and the use of waste as a resource should be considered wherever possible.

**Planning Policy Statement: Planning and Climate Change – Supplement to Planning Policy Statement 1 (2007)**
The PPS supplement supports the delivery of sustainable development which provides a full and appropriate response on climate change, through the integration of climate change considerations into spatial planning, including the consideration of adaptation and mitigation measures.

Spatial strategies should secure the highest viable resource and energy efficiency and reduction in emissions. New development, its spatial distribution, location and design should be planned to limit carbon dioxide emissions and to maximise opportunities for decentralised and renewable or low carbon energy. It should also help secure the fullest possible use of sustainable transport, including that for freight movement, and reduce the need to travel.

New development should also be planned to minimise future vulnerability and provide resilience to climate change, respond to the concerns of business and encourage competitiveness and technological innovation in mitigating and adapting to climate change. Plans should also expect all new development to include a proportion of energy supply which is from decentralised and renewable or low-carbon energy sources.

Planning authorities should consider identifying suitable areas for renewable and low-carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources but should avoid stifling innovation by rejecting proposals solely because they are outside areas identified for energy generation.

Planning authorities are expected to assess progress against the objectives of the PPS and as such Appendix A includes a table assessing the ways in which this document has contributed to these objectives.

**Planning Policy Statement 10: Planning for Sustainable Waste Management (2005)**
PPS 10 does not make specific reference to climate change, but does state that:

*"Through more sustainable waste management…the Government aims to break the link between economic growth and the environmental impact of waste. This means a step-change in the way waste is handled and significant new investment in waste management facilities. The planning system is pivotal to the adequate and timely provision of the new facilities that will be needed."*

Planning authorities should prepare and deliver strategies that drive waste management up the waste hierarchy and help to secure the recovery or disposal of waste without endangering human health and without harming the environment. Therefore site allocations should support the sustainable movement of waste, and products arising from resource recovery, seeking when practicable and beneficial to use modes other than road transport. Plans should also enable waste to be disposed of in one of the nearest appropriate installations.

**Planning Policy Statement 22: Renewable Energy (2004)**
This PPS relates to technologies such as onshore wind generation, hydro, photovoltaics, passive solar, biomass and energy crops, energy from waste (but not energy from mass incineration of domestic waste), and landfill and sewage gas.

It states that increased development of renewable energy resources is vital to facilitate the delivery of its commitments on climate change and renewable energy. In order to do this local development documents should promote and encourage the development of renewable energy resources, setting out criteria that will be applied in assessing applications for planning permission for renewable energy projects. Such projects include the production of biomass from the biodegradable fraction of industrial and municipal waste (31).

It promotes the view that small-scale projects can provide a valuable contribution to overall outputs of renewable energy and that planning applications should not be rejected simply because the level of output is small. It also states that planning authorities should not make assumptions about technical and commercial feasibility, as technological change could make excluded sites viable.

**Planning Policy Statement 25: Development and Flood Risk (2006)**
Planning can help to avoid, reduce and manage flood risk by taking full account of present and future flood risk, and the wider implications for flood risk of development located outside flood risk areas. The aims of the PPS are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. As such, local planning authorities should prepare and implement planning strategies that help to deliver sustainable development by appraising, managing and reducing risk through a partnership approach.

It sets out a risk-based Sequential Test which should be applied at all stages of planning, with an aim of steer new development to areas at the lowest probability of flooding. The overall aim of decision-makers should be to steer new development to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, decision-makers should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2. Only where there are no reasonably available sites in Flood Zones 1 or 2 should decision-makers consider the suitability of sites in Flood Zone 3, taking into account the flood risk vulnerability of land uses.

The PPS sets out flood risk vulnerability categories for different types of development. Landfill and management facilities are considered 'More vulnerable', with other waste treatment and sewage treatment plants are considered 'Less vulnerable'. This has an impact on the flood zone in which they are felt to be compatible, as illustrated in Table 2. It also introduces an exception test, for this to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk;  the development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and a Flood Risk Assessment must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. This test must only be applied after the sequential test, where indicated in Table 2.

**Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility'**

| Flood Risk Vulnerability classification (see Table D2) | | Essential Infrastructure | Water compatible | Highly Vulnerable | More Vulnerable | Less Vulnerable |
|---|---|---|---|---|---|---|
| Flood Zone (see Table D.1) | Zone 1 | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Zone 2 | ✔ | ✔ | Exception Test required | ✔ | ✔ |
| | Zone 3a | Exception Test required | ✔ | ✗ | Exception Test required | ✔ |
| | Zone 3b 'Functional Floodplain' | Exception Test required | ✔ | ✗ | ✗ | ✗ |

Key:

✔ Development is appropriate

✗ Development should not be permitted

Within each Flood Zone, new development should be directed first to sites at the lowest probability of flooding.

# Regional

**West Midlands Regional Climate Change Action Plan (2007)**
The Action plan sets out a vision of a sustainable low carbon economy in the region with significantly reduced greenhouse gas emissions. Likely climate change impacts should be identified and adapted to and partners should demonstrate effective leadership, championing the climate change agenda across all sectors.

It set out actions that regional organisations can take over the next three years. Waste planning is identified as one element which can deliver substantially reduced emissions and can deliver resilience to likely climate change impacts.

**West Midlands Regional Energy Strategy (2004)**
The strategy's main aim is to make the West Midlands the most energy efficient region in the UK, having ensured a sustainable, secure and affordable supply of energy for everyone and strengthened the region's economic capability. This would be done by reducing energy demand and increasing the use of low emission renewable energy sources.

Although there are five municipal waste incinerators in the West Midlands, the Strategy does not give detailed consideration to waste incineration as it is felt to be better dealt with in the Regional Waste Strategy (included with in the RSS). It does however note that the region's renewables capacity is mainly landfill gas (36MW) and sewage gas (11MW). Table 3 shows that the contribution of waste and renewables to the overall energy consumption is low.

**Table 3: West Midlands Energy Consumption Estimate 2002 (GWh)**

| | Coal and solid fuel | Petroleum products | Natural gas | Renewables and waste | Electricity | Total (GWh) | Total (Kt $CO_2$) |
|---|---|---|---|---|---|---|---|
| **Industry** | 3,816 | 8,961 | 20,555 | 227 | 14,018 | 47,578 | 13,229 |
| **Commerce, public sector** | 46 | 1,812 | 8,597 | 189 | 8,280 | 18,925 | 5,643 |
| **Domestic** | 1,939 | 3,876 | 34,695 | 261 | 10,559 | 51,330 | 12,644 |
| **Transport** | - | 42,047 | - | - | 108 | 42,154 | 10,138 |
| | | | | | | | |
| **Total (GWh)** | 5,801 | 56,695 | 63,848 | 678 | 32,966 | 159,987 | |
| **Total (Kt $CO_2$)** | 1,740 | 13,607 | 12,131 | | 14,175 | | 41,653 |

Source: *West Midlands Energy Strategy* (2004) developed by a Partnership Steering group with support from West Midlands Regional Assembly, Advantage West Midlands, Government Office for the West Midlands.

Table 4 breaks this down further and shows the contribution of waste to renewable electricity generation in the west Midlands in 2001. It is clear that incineration provides the largest contribution.

**Table 4: Estimate of West Midlands Renewable Electricity Generation (2001)**

| Source | Mass burn incineration | Landfill Gas | Sewage Gas | Hydro | PV | Wind | Biomass |
|---|---|---|---|---|---|---|---|
| **Current (GWh/yr)** | 502 | 240 | 47 | 3 | 0.1 | 0 | 0 |

Source: *West Midlands Energy Strategy* (2004) developed by a Partnership Steering group with support from West Midlands Regional Assembly, Advantage West Midlands, Government Office for the West Midlands.

## West Midlands Regional Spatial Strategy

According to PPS10, RSSs should provide sufficient opportunities to meet the identified waste management needs of their area for all waste streams. In turn, planning authorities should prepare local development documents that reflect their contribution to delivering the RSS[6]. Following the change of government in May 2010, the Regional Spatial Strategies have been revoked and as such no longer form part of the development plan. However, the evidence upon which the RSS and RSS phase 2 revision was based is still considered to be valid and the ideas in the RSS reflect national policy; as such, they are still being considered in the development of the Waste Core Strategy.

Climate Change was identified as a key consideration in the RSS. The strategy included a number of mechanisms for responding to climate change. These included encouraging the use of sustainable drainage systems, increasing tree cover, promoting the reuse of materials, supporting new industries and technologies that address climate change, and encouraging renewable energy and energy conservation.

The Energy Policies in particular recognised greenhouse gas emissions and state that the region should aspire to double the 'renewables' share of electricity between 2010 and 2020. Energy from waste is identified as having the potential to contribute towards this aspiration.

[6] *PPS10* (2005) p6

In the West Midlands Regional Spatial Strategy Revision, Climate Change was identified as a key challenge facing the West Midlands region and planning policies was felt to have a major role to play in tackling climate change, including contributing towards the national objective to reduce carbon dioxide emissions.

In included requirements that local authority policies and proposals should mitigate and adapt to the worst impacts of climate change by developing and using renewable energy to supply both new and existing development, reducing the need to travel and reducing the amount of biodegradable waste going to landfill. These elements should've been monitored. Plans and policies should enhance, link and extend natural habitats so that biodiversity can adapt to climate change and hence help to mitigate its affects by reducing 'heat islands', acting as carbon 'sinks', absorbing flood water and providing renewable energy.

It also included requirements that all new development:

> *(i) minimise resource demand and encourage the efficient use of resources, especially water, energy and materials;*
> *(ii) encourage the construction of climate-proofed developments and sustainable buildings to help ensure their long-term viability in adapting to climate change;*
> *(iii) avoid development in flood zones, protect essential infrastructure against flooding, and promote the use of sustainable drainage techniques and natural flooding of land in appropriate locations….*
> *(v) facilitate effective waste management;*
> *(vi) protect, conserve, manage and enhance environmental and natural and built heritage assets.*

It integrated climate change considerations relating to sustainable construction and design, sustainable locations for new development and sustainable transport and access into the strategy as a whole. It also stated that proposals for renewable energy sources, including from waste combustion and landfill gas should be encouraged.

The RSS revision expressed a preference for waste sites with current use rights for waste management purposes, active mineral working sites or landfills, previous or existing industrial land, contaminated or derelict land, Land within or adjoining a sewage treatment works or redundant agricultural or forestry buildings and their curtilage (policy W5). In contrast it promotes the use of onsite renewable energy generation in all developments and the development of a decentralised energy infrastructure. This could result in potential conflict where energy recovery from waste is involved, especially for small-scale 'community' anaerobic digestion facilities.

Although the RSS has been revoked, the approach taken was inline with national policy and as such is still felt to be useful in informing the development of the Waste Core Strategy.

# Local

**Worcestershire Local Area Agreement**
A Local Area Agreement (LAA) is a three-year agreement that sets out the priorities for a local area. It is negotiated with government and the local area represented by

the local authorities and their partners working through the Worcestershire Partnership. The Worcestershire Partnership LAA includes priorities to:

- Improve energy efficiency and increase the proportion of energy generated from renewable sources;
- Improve flood mitigation measures and improve drainage;
- Maximise the diversion of waste away from landfill through prevention, reuse, recycling/composting and recovery.

Full details of these targets are set out in Appendix 2.

**Worcestershire Partnership Climate Change Strategy Revision 2009**

The strategy concentrates predominantly on adaptation to climate change and the reduction of $CO_2$ emissions but also addresses the need to reduce other greenhouse gases such as methane. It sets out the ways in which the Local Area Agreement, target of 9% reduction in $CO_2$ emissions per capita from 2005 by 2011 can be met. The Government will contribute 7.1% from national measures, but the Worcestershire Partnership will be responsible for at least a 1.9% reduction (approximately 75,000 tonnes).

The strategy aims to achieve at least a 34% cut in emissions by 2022 and at least 80% by 2050 in line with national targets, and ultimately becoming a carbon neutral County. It is felt that minimising waste production, reducing the amount of waste sent to landfill sites, and exploring the potential for using waste products as a useful resource will contribute to these targets. As such the strategy aims to ensure that the Waste Core Strategy addresses climate change and that specific policies and guidance on the exploitation of renewable energy resources are included in all strategic and local development plans.

Since the publication of the initial strategy in 2005 total levels of household waste produced in Worcestershire have declined and the percentage going to landfill has fallen for household waste from 77% in 2004 to 53% in 2007/8 and for commercial and industrial waste from 67% in 2004 to 55% in 2007/8. In addition climate change producing gases such as Methane are tapped and used for fuel at Hill and Moor and Martley landfill sites.

Further waste management issues are considered in the 2008 review, which:

- supports the development of new waste management facilities in the County,
- seeks to promote small scale diversification and business projects which include bio and renewable energy installations and recycling/waste equipment;
- seeks to develop the potential of utilising waste products to create a localised energy supply and
- will continue to explore the potential of tapping methane as fuel at further landfill sites in the County.

Whilst the Strategy views energy efficiency as key in reducing Worcestershire's $CO_2$ emissions, it also considers electricity and heat generation from renewable energy sources (such as wind, water, solar, & biomass[7]). Due to the physical nature of the County biomass is thought to be one of the technologies with the greatest potential.

[7] Biomass is the biodegradable fraction of products, waste and residues from agriculture (including plant and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste. (Planning Policy Statement 22, ODPM (now DCLG) 2004)

Although it is recognised that the greatest carbon savings will be achieved through a mix of appropriate technologies, at a mix of scales the Strategy identifies an aim to consider the potential of organic waste to generate renewable energy.

Transport is identified as an issue in the County with a 3% increase in average mileage between 2004 and 2006, it accounts for 28% of the total emissions for the County and a significant sector contributing to $CO_2$ emissions.

## *Relevant Targets:*

- A reduction of at least 21,000 tonnes CO2 from transport by 2011.
- Waste Management to contribute to the 1.9% local reduction in $CO_2$ emissions from 2005 levels by 2011.
- Reduce the amount of municipal waste going to landfill to 22% or less of total amount produced by 2015.

**The Joint Municipal Waste Strategy for Herefordshire and Worcestershire 2004 – 2034 First Review 2009**

A key principle of the Joint Municipal Waste Strategy is "*meeting the challenge of Climate Change by viewing waste as a resource"* by cutting down on the amount of waste produced, reducing the use of natural resources, recycling materials and recovering energy from those can no longer be used.

The Strategy views waste as a resource and seeks to both maximise its potential and to understand the environmental impacts. It aims to ensure that policies and collection and treatment methods reduce the impact of resource depletion and Greenhouse Gas emissions. As such it states that the Local Authorities will actively seek to provide waste management services in a manner that minimises greenhouse gas emissions and other impacts that contribute to Climate Change and continue to work on waste prevention, re-use and recycling schemes and raise awareness of the links between these and Climate Change. One element of this strategy is to encourage home composting, which can reduce the amounts of waste going to landfill and therefore the amount of landfill gas arising as a result.

Several potential options for treating residual waste were considered in Annex D of the strategy. Global warming potential was one of the factors considered. Carbon dioxide and other greenhouse gas emissions were taken into account (36).

## *Relevant Targets:*

We are currently gathering baseline data in order to measure our performance against the new National Indicators 185 and 186. Once this data has been gathered for a year, we can then set a meaningful Climate Change target, which will be included as a key target within the Strategy

- National Indicator 185: $CO_2$ reduction from Local Authority operations;

# Appendix 2: Requirements of Planning Policy Statement: Planning and Climate Change - Planning Policy Statement 1

| Requirement | Contributed towards |
|---|---|
| **Key Planning Objectives** | |
| Prepare, and manage the delivery of, spatial strategies that make a full contribution to delivering the Government's Climate Change Programme and energy policies, and in doing so contribute to global sustainability. | ✓ |
| Prepare, and manage the delivery of, spatial strategies that in providing for the homes, jobs, services and infrastructure needed by communities and in renewing and shaping the places where they live and work, secure the highest viable resource and energy efficiency and reduction in emissions. | ✓ |
| Prepare, and manage the delivery of, spatial strategies that deliver patterns of urban growth and sustainable rural developments that help secure the fullest possible use of sustainable transport for moving freight, public transport, cycling and walking; and, which overall, reduce the need to travel, especially by car. | ✓ |
| Prepare, and manage the delivery of, spatial strategies that secure new development and shape places that minimise vulnerability, and provide resilience, to climate change; and in ways that are consistent with social cohesion and inclusion. | ✓ |
| Prepare, and manage the delivery of, spatial strategies that conserve and enhance biodiversity, recognising that the distribution of habitats and species will be affected by climate change. | ✓ |
| Prepare, and manage the delivery of, spatial strategies that reflect the development needs and interests of communities and enable them to contribute effectively to tackling climate change. | ✓ |
| Prepare, and manage the delivery of, spatial strategies that respond to the concerns of business and encourage competitiveness and technological innovation in mitigating and adapting to climate change. | ✓ |
| **Decision-making principles** | |
| The proposed provision for new development, its spatial distribution, location and design should be planned to limit carbon dioxide emissions. | ✓ |
| New development should be planned to make good use of opportunities for | ✓ |

| Requirement | Contributed towards |
|---|---|
| decentralised and renewable or low carbon energy. | |
| New development should be planned to minimise future vulnerability in a changing climate. | ✓ |
| Climate change considerations should be integrated into all spatial planning concerns. | ✓ |
| Mitigation and adaptation should not be considered independently of each other, and new development should be planned with both in mind. | ✓ |
| Sustainability appraisal (incorporating strategic environmental assessment) should be applied to shape planning strategies and policies that support the Key Planning Objectives. | Not applicable for this document. |
| Appropriate indicators should be selected for monitoring and reporting on in planning authorities' annual monitoring reports. | ✓ |
| **Local Development documents: Planning Authorities should….** | |
| provide a framework that promotes and encourages renewable and low-carbon energy generation. Policies should be designed to promote and not restrict renewable and low-carbon energy and supporting infrastructure. | ✓ |
| take into account the extent to which existing or planned opportunities for decentralised and renewable or low-carbon energy could contribute to the energy supply of development; | ✓ |
| take into account whether there is, or the potential for, a realistic choice of access by means other than the private car and for opportunities to service the site through sustainable transport. | Considered elsewhere |
| take into account the capacity of existing and potential infrastructure to service the site or area in ways consistent with cutting carbon dioxide emissions and successfully adapting to likely changes in the local climate; | ~ |
| take into account the ability to build and sustain socially cohesive communities with appropriate community infrastructure, having regard to the full range of local impacts that could arise as a result of likely changes to the climate; | ✓ |
| take into account the effect of development on biodiversity and its capacity to adapt to likely changes in the climate. | ✓ |
| take into account the contribution to be made from existing and new opportunities for open space and green infrastructure to urban cooling, sustainable drainage systems, and conserving and enhancing biodiversity | ✓ |
| take into account known physical and environmental constraints on the development of land such as sea level rises, flood risk and stability, and take a precautionary approach to increases in risk that could arise as a result of likely changes to the climate. | ✓ |

| Requirement | Contributed towards |
|---|---|
| have an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies, including microgeneration, to supply new development in their area. | ✓ |
| Drawing from this evidence-base, and ensuring consistency with housing and economic objectives, planning authorities should: | |
| (i) set out a target percentage of the energy to be used in new development to come from decentralised and renewable or low-carbon energy sources where it is viable. The target should avoid prescription on technologies and be flexible in how carbon savings from local energy supplies are to be secured. | ✓ |
| (ii) where there are particular and demonstrable opportunities for greater use of decentralised and renewable or low-carbon energy than the target percentage, bring forward development area or site-specific targets to secure this potential | ~ |
| (iii) and, in bringing forward targets, set out the type and size of development to which the target will be applied; and | ✓ |
| (iv) ensure there is a clear rationale for the target and it is properly tested | ✓ |
| In considering a development area or site-specific target, planning authorities should pay particular attention to opportunities for utilizing existing decentralised and renewable or low-carbon energy supply systems and to fostering the development of new opportunities to supply proposed and existing development. Such opportunities could include co-locating potential heat customers and heat suppliers. | ~ |
| Planning authorities, developers and other partners in the provision of new development should engage constructively and imaginatively to encourage the delivery of sustainable buildings. Accordingly, planning policies should support innovation and investment in sustainable buildings and should not, unless there are exceptional reasons, deter novel or cutting-edge developments. Planning authorities should help to achieve the national timetable for reducing carbon emissions from domestic and non-domestic buildings. | ✓ |
| When proposing any local requirement for sustainable buildings planning authorities should: | |
| • focus on development area or site-specific opportunities; | ~ |
| • specify the requirement in terms of achievement of nationally described sustainable buildings standards; | ✓ |
| • ensure the requirement is consistent with their policies on decentralised energy; and | ✓ |
| • not require local approaches for a building's environmental performance on matters relating to construction techniques, building fabrics, products, fittings or finishes, or for measuring a building's performance unless for reasons of landscape or townscape. | ✓ |
| Any policy relating to local requirements for decentralised energy supply to | |

| Requirement | Contributed towards |
|---|---|
| new development or for sustainable buildings should be set out in a DPD, not a supplementary planning document, so as to ensure examination by an independent Inspector. In doing so, planning authorities should: | |
| • ensure what is proposed is evidence-based and viable, having regard to the overall costs of bringing sites to the market (including the costs of any necessary supporting infrastructure) and the need to avoid any adverse impact on the development needs of communities | Considered in the IT Power report |
| • in the case of housing development and when setting development area or site-specific expectations, demonstrate that the proposed approach is consistent with securing the expected supply and pace of housing development shown in the housing trajectory required by PPS3, and does not inhibit the provision of affordable housing; and | Not Applicable. |
| • set out how they intend to advise potential developers on the implementation of the local requirements, and how these will be monitored and enforced. | ✓ |
| **Monitoring** | |
| Annual monitoring should assess progress against the objectives of this PPS and be integrated with monitoring of housing delivery and other policies. Annual monitoring reports should describe performance and, as necessary, the action intended to improve implementation or to update the strategy. | ✓ |

# Appendix 3: Targets

## Local Area Agreement Targets

| Priority | Indicator(s), | Baseline | LAA Improvement Target | | |
|---|---|---|---|---|---|
| | | | 08/09 | 09/10 | 10/11 |
| To increase energy efficiency and increase the proportion of energy generated from renewable sources | NI 186: Per capita CO2 emissions in the LA area | 7.2 tonnes per capita (2005) | 3.0% reduction compared with 2005<br><br>(2.4% from national measures, 0.6% from local measures) | 6.0% reduction compared with 2005<br><br>(4.7% from national measures, 1.3% from local measures) | 9.0% reduction compared with 2005<br><br>(7.1% from national measures, 1.9% from local measures) |
| To improve flood mitigation measures and improve drainage | NI 188: Adapting to climate change | Level 0 | All Districts & County to achieve at least level 1 | All Districts to achieve at least level 1 & County to achieve level 2 | All Districts to achieve at least level 2 & County to achieve level 3 |
| | All vulnerable areas identified, integrated flood risk management plans developed and implemented.<br><br>Improved flood-warning system in place at Parish level. | 0 | 5% of total | 50% of total | 100% of total |
| To maximise the diversion of waste away from landfill through prevention, reuse, recycling/composting and recovery | NI 193 Municipal waste land filled | 57%(2006-07) | 53% | 51% | 48% |

Source: http://www.worcestershirepartnership.org.uk/home/index/wp-laa.htm

# Appendix 4: Worcestershire Waste Core Strategy Background Documents

To help provide a robust evidence base for the Waste Core Strategy the Council has prepared a series of background documents. These outline current thinking and have informed the approach taken to date in the development of the waste core strategy. All of these background documents are *living document* and are in a state of development and comments are invited on all available documents during the consultation period.

## Key Themes

- *Towards a Vision Statement*: sets out the vision which is driving the Waste Core Strategy and details how it has evolved through consultation process.

- *Spatial Portrait:* provides additional detail to the spatial portrait set out in this consultation. It includes a description of the County and the local factors that need to be taken into account in developing the Waste Core Strategy.

- *Spatial Strategy:* Set out how the Spatial Strategy for the WCS has been developed

- *Arisings and capacity gap:* considers waste arisings in Worcestershire and makes projections about future arisings, treatment capacity and the need for facilities.

- *Monitoring Baseline*: Establishes the baseline for indicators set out in the WCS monitoring schedule and makes recommendations for those indicators that are not currently monitored

- *Identifying 'areas of search'*: sets out the approach to identifying locations suitable for waste management development, termed 'areas of search' and details all of the alternatives methods considered. It lists all potential locations assessed and details why they were, or were not, considered suitable for waste management development. This document has been informed by *ERM Industrial Estate Report.*

- *Climate Change:* is intended to form a basis for addressing climate change issues in the Waste Core Strategy. It considers mitigation through the reduction of greenhouse gas emissions, energy demands and the adaptation of waste management facilities to climate change.

- *Links with Districts & Neighbouring Local Authorities Plans and Strategies:* identifies the aspects of the guidance 'Creating Strong, Safe and Prosperous Communities' which are relevant to the production of the Waste Core Strategy. As a result of the guidance, this paper goes on to examine the links to waste in

Worcestershire's Districts and neighbouring Local Authorities plans and strategies. It also evaluates what these links mean for the Waste Core Strategy.

- *Waste Sites in Worcestershire:* details existing waste management operations in Worcestershire and analysis of the relationship between size and throughput. In order to gain this information, the majority of known waste sites in the County were visited between September 2008 and July 2009. During these visits operators were asked about any issues currently faced, any future changes anticipated, these meetings are summarised in the report.

- *Inland Waterways:* The document was developed in response to consultation comments received on behalf of British Waterways regarding the Worcestershire County Council Waste Core Strategy: Refreshed Issues & Options Consultation. It sets out the policy context relating to Inland Waterways in Worcestershire.

- *Waste Freight by Rail:* considers the potential for movements of waste by rail in Worcestershire.

# Waste Streams

- *Municipal Waste:* sets out the national and local policy context. It also includes details of the waste arisings and available capacity for treatment of municipal waste within the County.

- *Commercial and Industrial Waste:* sets out the national and local policy context. It also includes details of the waste arisings and available capacity for treatment of municipal waste within the County.

- *Construction and Demolition Waste:* sets out the national and local policy context. It also includes details of the waste arisings and available capacity for treatment of municipal waste within the County.

- *Agricultural Waste:* considers waste arising from agricultural activities in Worcestershire. It examines what agricultural waste is, how it is treated and explores the planning permitted development rights. and identifies the potential options for making provision through the Waste Core Strategy.

- *Hazardous Waste:* The document considers hazardous waste arising in Worcestershire. It includes information relating to hazardous waste in a national and regional policy context and includes details of the demand and available capacity for the treatment of hazardous waste within the County.

- *Waste Arisings from Healthcare and Related Activities - Clinical Waste and Low Level Radioactive Waste:* considers waste arising from health care and related activities, focusing on Clinical waste; and Non-nuclear low level radioactive waste. It includes information relating to clinical waste and non-nuclear low level radioactive waste in a policy context. It also includes details of the demand and available capacity for treatment of clinical and non-nuclear low level radioactive waste within the County.

Annex I considers low level radioactive waste from the nuclear industry in more detail, however it is not felt to be a significant issue in the County and is, therefore, not considered in the main body of the report.

# Management Facilities

- *Types of Facilities:* is intended to be a simple guide that gives an overview of the processes that tend to happen at a range of different facilities and lists the things that might need to be thought about when deciding where a facility would be best situated. It also sets out some of the possible impacts and benefits of each type of facility.

- *Landfill* includes background data and considers issues around types of landfill and the policy context. It also details of the demand and available capacity for landfill within the County, based on EA data and the Council's own research.

- *Metal Recycling Sites:* considers all sites in Worcestershire involved in the recycling of metal, this includes sites which sort, bulk and/or process metal and any other sites that form part of the chain of processes of recycling waste metal into a material which can be re-used. It sets out the context and background data relating to metal recycling, detailing the demand and available capacity for metal recycling within the County.

- *Waste Transfer Stations:* considers Waste transfer stations, looking at the current need and capacity in Worcestershire and wider policy context.

- *Resource Recovery from Biodegradable Waste - Composting and Anaerobic Digestion* The document considers composting and anaerobic digestion. These treatment options are considered in the same document as they both offer the opportunity to recover resources from biodegradable waste. It sets out the context and background data relating to composting and anaerobic digestion.

- *Recovering Energy from Waste - Biological and Thermal Treatment Technologies:* sets out the context and background data relating to biological and thermal technologies for recovering energy from waste including anaerobic digestion, incineration and refuse derived fuels. There is some overlap with the Worcestershire Waste Core Strategy Background Document: Resource Recovery from Biodegradable Waste: Composting and Anaerobic Digestion.

- *Waste Water Treatment Infrastructure:* examines the need for waste water treatment infrastructure in Worcestershire. It includes information relating to waste water treatment policy context. It also proposes a possible way forward for the potential issues regarding who is responsible for what aspects of managing waste water treatment and related development.

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# Glossary

**Carbon Sequestration**
Storage of carbon in a form which is unavailable to the natural carbon cycle over a sufficiently long period; e.g. carbon sequestered in soil from waste which has been composted and used on the land.

**EFW**
Energy from waste – In this context the term has been used to describe incineration with energy recovery, however energy from waste can come from heat treatment, such as incineration or biological method such as anaerobic digestion.

**IVC**
In-vessel composting – this is the degradation of putrescible waste carried out in a closed container, in the presence of oxygen.

**MBT**
Mechanical Biological Treatment - used to treat the waste remaining after waste has been sorted for recycling and composting. In its simplest form MBT provides a drying and bulking reduction operation prior to landfill. However, other MBT systems are designed to:[8]

- treat and separate out materials (such as metals and glass) from residual waste for recycling,
- produce a combustible fraction (sometimes known as refuse derived fuel or solid recovered fuel) for energy recovery,
- produce an organic rich fraction (derived from, for example, food and garden waste and paper/card), which may have a use as landfill cover or for land restoration.

The remaining residual waste is sent for energy recovery, or disposed of to landfill.

**MSW**
Municipal Solid Waste

**RDF**
Refuse Derived Fuel

**KWh**
Kilowatt hour: a measure of energy production.

**Putrescible waste**
Putrescible waste is that which will decompose, such as food or green wastes.

[8] Defra (2007) *Waste Strategy for England Annex C1* p2