Report

AEAT/ED51487

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Environmental Options Assessment for municipal waste in Darlington

Final Report Produced for Darlington Borough Council

January 2006

AEA TECHNOLOGY
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Executive Summary

Darlington Borough Council is looking to improve the performance of the waste management service to deliver recycling and recovery targets of central government. The improvement of the recycling and recovery rates as well diversion of materials away from landfill will reduce environmental impacts and prove to be a more sustainable method of managing waste. In addition, the requirements of the Landfill Directive and the resultant Landfill Allowances Trading Scheme (LATS) and the rising costs of treatment and landfill are making future waste management increasingly more expensive. All of these pressures mean that Darlington has to evaluate new or revised waste management options. Recycling alone will not enable Darlington to achieve compliance with the Landfill Directive. The waste management system that is adopted has to form the best balance of environmental, financial and operational factors that is termed the Best Practicable Environmental Option (BPEO).

The Government's Waste Strategy 2000 recommends that a BPEO assessment be conducted to help identify the 'best' option for waste management in a particular region. The overall objective of this study is to ensure that the various waste management options under consideration for Darlington are assessed to ensure the protection of the environment and to further sustainable development.

Seven different waste management scenarios have been considered for Darlington that focus on the potential impact of different treatment technologies and facilities and collection systems. Each scenario will have different environmental, social and economic impacts all of which will need to be considered when planning for waste management in Darlington. The principal aspects of these scenarios are listed below:

Base Case - Landfill based
No changes to recycling levels (23%) and no new facilities introduced. Main disposal route through landfill.

1. **Maximised Waste Minimisation and high recycling**
   Waste minimisation activities increased and recycling performance increased to 40%. Include Biowaste waste (green & kitchen waste) collection using 140 ltr wheeled bin collected fortnightly. In-vessel composting (IVC) facility for biowaste collected. Main disposal route through landfill.

2. **Energy from Waste Incineration within Darlington**
   No changes to collection recycling levels (23%). New Energy from Waste (EfW) facility within Darlington taking residual waste.

3. **Energy from Waste Incineration at a site outside Darlington**
   No changes to collection recycling levels (23%). Energy from Waste (EfW) facility outside Darlington taking residual waste.

4. **Mechanical Biological Treatment facility within Darlington**
   Increased recycling performance (35%) via residual treatment facility and biowaste (green & kitchen waste) collection using 140 ltr wheeled bin collected fortnightly. New in-vessel composting facility constructed for biowaste and new Mechanical Biological Treatment Facility with Anaerobic Digestion (MBT-AD) facility within Darlington

taking residual waste and the Refuse Derived Fuel (RDF) going to a 3rd party for combustion.

5. **Gasification facility within Darlington**
   No changes to recycling collection levels (23%). New Gasification facility within Darlington taking residual waste.

6. **Energy from Waste Incineration within Darlington and increased recycling**
   Increased recycling performance (29%) via green waste collection using 140 ltr wheeled bin collected fortnightly. New Energy from Waste (EfW) facility within Darlington taking residual waste.

The sites identified and modelled in the scenarios are only used to determine the distances for the transport impacts and are representative of sites that are in the general geographical area required to appropriately serve Darlington. The use of a particular site does not infer any preference for the site in planning terms other than it is compliant with the geographical spread of the BPEO. However, all new uses for sites will require to be assessed under the planning regime and the normal decision criteria on site viability will apply. The sites identified in this report have been selected from sites used as existing waste management facilities or are owned by Darlington Borough Council.

The infrastructure to deliver these scenarios was evaluated and assessed against a range of criteria based on environmental, socio-economic and operational issues. Combining these assessments and applying weighting factors to reflect the relative importance of each criterion enabled overall scores to be calculated for each scenario. The weighting factors were developed from assessments by a cross section of officers representing different departments in Darlington Borough Council.

The results show that diversion of waste away from landfill is the best option. Generally, thermal treatment plants score well because they benefit from the additional energy production offsetting the use of fossil fuel. The results highlighted a limitation of the MBT process with less material diverted from landfill and reduced energy recovery than thermal treatment technologies. This impacts its performance in the WISARD analysis and resultant environmental objective scores. Also the technology is sensitive to the determination of markets for the RDF product and compost product that are yet to be identified or established.

This analysis shows that Scenario 3 (EfW outside Darlington) is ranked the highest. This scenario generally scores well across all criteria but particularly well due to a lesser extent of site and planning related issues due to utilising a 3rd party facility outside of Darlington. However this scenario is dependant on a facility with capacity being available to Darlington.

The costs for all the thermal combustion scenarios are the least expensive options and have little variation. The costs of having an EfW plant within Darlington or utilising spare capacity in a 3rd party emerge quite similar and the determining factors will be securing a 3rd party gate fee at a cost cheap enough to make the additional transport worthwhile.

The overall costs will be evaluated with greater depth within the tendering process. Furthermore, the cost implications of not achieving or maintaining the anticipated recycling target in the long-term and the sensitivity to LATS values should be assessed within the tendering process.

A BPEO waste management solution is not necessarily one of the scenarios assessed, but the modelled scenarios are merely to illustrate the key policies that will be typified by the BPEO solution. Examination of the results shows some key aspects of the waste management solution that will go to form the Best Practicable Environmental Option (BPEO) for managing waste in Darlington, they include:

- Diversion of waste from landfill
- Energy recovery through thermal treatment is favourable.
- MBT technology has uncertainty of markets for RDF and compost/digestate that needs to be considered.
- Improvement of the recycling and composting performance is beneficial and can aid the diversion of biodegradable municipal waste (BMW), potentially reducing the extent residual treatment facilities are required.
- Utilisation of a 3rd party treatment facility can be preferential but has significant risks with deliverability of the waste management solution.

Therefore, solutions that maximise these aspects will form the BPEO for Darlington.

Contents

Appendices

1 THE NEED FOR CHANGE

1.1 AIMS & OBJECTIVES OF THE REPORT

This document is an assessment of the Best Practicable Environmental Option (BPEO) for managing waste in Darlington. It contains the proposals for addressing the key issues surrounding waste management in both the short-term and long-term future.

This BPEO assessment concentrates on municipal waste (i.e. household and trade waste collected and disposed of by Darlington Borough Council). The Government's Waste Strategy 2000 requires that a BPEO assessment be conducted to help identify the 'best' option for waste management in a particular region.

The overall objective of this study is to ensure that the various waste management options under consideration for Darlington are assessed to ensure the protection of the environment and to further sustainable development. Seven (7) different waste management scenarios were considered as part of this BPEO. Each will have different environmental, social and economic impacts all of which will need to be considered when planning for waste management in the Darlington area.

The objectives of the report are:

- To show how Darlington Borough Council potentially can meet the EU Landfill Directive targets for diverting municipal biodegradable waste away from landfill in both the long and short term.

- Demonstrate how Darlington Borough Council can meet the recycling targets placed on them by central government.

- To identify a range of waste management technologies that can form part of the BPEO solution for Darlington's municipal waste.

- To provide an assessment of the BPEO to
    - support the formulation of the Development Framework
    - allow planning policies to be developed, and
    - to allow a framework on which individual planning applications can be assessed in terms of their impact on the whole waste management system.

1.2 THE CHALLENGES FACING DARLINGTON – WHAT NEEDS TO BE DONE?

Most of the residual waste in Darlington has historically been disposed of through landfilling outside the borough. However, due to changes in legislation emanating from Europe, especially the Landfill Directive and national targets for recycling, this can no longer be seen as the most sustainable solution.

Sustainable waste management alternatives need to be identified, as disposing of ever-increasing amounts, and a greater variety of wastes, is becoming progressively more difficult. These sustainable alternatives include recycling, composting and energy recovery that make better use of resources and decrease the risks of pollution.

The Government's *'Waste Strategy 2000'* embodies the steps required to bring about this change and Darlington is required to play its part in this. In 2004/05 Darlington produced 57,005 tonnes of municipal waste, of which 17.5% was recycled or composted and 82.5% was landfilled. However, Government targets mean that Darlington must reduce the amount of biodegradable municipal waste (BMW) going to landfill to approximately 35% of 1995 levels by 2020. The Strategy Unit report "Waste not want not" notes that waste production is rising by approximately 3% a year, which is coupled with an increase in the number of households. If these levels of growth continue, there will be more than a doubling of the amount of waste Darlington will have to deal with. Recent evidence published by the Environment Department (DEFRA) shows that over the past three years household waste grew by a national average of only 1.4% per annum and municipal wastes by a national average of 2.2%. Targets have also been set by the Government for waste recovery and recycling which must be met in the longer term up to 2015.

1.3 LEGISLATIVE DRIVERS FOR WASTE MANAGEMENT

1.3.1 The National Waste Strategy

In response to European legislation, and international concern over the environmental impacts of waste disposal, the Government have published '*Waste Strategy 2000*'. The strategy sets out a national framework for reducing the amount of waste going to landfill by moving towards more sustainable waste management options. The overall aim is to tackle the growth in waste production and, where waste is produced, maximise the amount recovered through increased re-use, recycling, and composting and energy recovery.

Waste Strategy 2000

An over-arching policy document that is the Government's response to obligations on waste issues contained in European Law. Accordingly, it is both a national waste management plan (as required by European Council Directives 75/442/EEC, amended by 91/156/EEC and 96/350/EC Framework Directive on Waste) and a strategy to divert waste away from landfills (European Council Directive 1999/31/EC).

By managing waste and resources more efficiently, Darlington and the UK as a whole, can make an important contribution towards sustainable development. This is defined as "*development that meets the needs of the present, without preventing future generations from meeting their own needs*". The Government's sustainable development strategy is based on four key elements:

- Effective protection of the environment

- Prudent use of natural resources
- Social progress which meets the needs of everyone
- High and stable levels of economic growth and employment

Guiding principles for the National Waste Strategy

To ensure that future waste decisions take into account the factors fundamental to sustainable waste management, the Government has advised the following guiding principles be taken into account:

The Best Practicable Environmental Option (BPEO)
The BPEO process should be used when considering the relative merits of various waste management options. This will establish the option that provides the most benefits or the least damage to the environment as a whole, at an acceptable cost, in the long term as well as the short term. This may mean there is a different BPEO for the same waste stream in a different area or at a different time. The process also ensures that local, environmental, social and economic issues will be important in any decision.

The national waste strategy is currently being revised. The requirement for a BPEO assessment is likely to be removed. However Waste Disposal Authorities will have to consider how to evaluate options for future waste management.

Planning Policy guidance states that waste strategies should be based on a systematic consideration of alternative options in the form of a Strategic Environmental Assessment (SEA). SEA assessments should consider environmental, social and economic factors. Consequently the BPEO process can still be used as a tool to assess alternative options for a range of environmental socio-economic and operational criteria.

The Waste Management Hierarchy
This theoretical framework ranks waste management options in order of sustainability. If waste management is to become sustainable there needs to be an increased consideration of the options towards the top of the hierarchy.

REDUCE:	The most effective environmental solution may often be to reduce waste generation in the first place, for example, ensuring products are not over packaged.
RE-USE:	Where further reduction is not possible some materials and products can be used again for either the same or a different purpose.
RECYCLING	Where direct re-use is not possible, materials can be recycled or may be used in production processes as secondary raw materials.
RECOVERY:	If reduction, re-use or recycling is not possible, the next best thing is to regain as much value from the waste as possible through energy recovery.
DISPOSAL:	If none of the previous options offer an appropriate solution only then should the waste be disposed of.

When assessing waste management proposals the waste hierarchy should be used as a guide rather than being applied rigidly. A certain amount of flexibility is needed to arrive at the most balanced environmental, social and economic solution and inevitably is likely to contain a mixed solution.

Recycling Targets

Within the overall recycling/recovery targets the Government has specified the following statutory targets for recycling as shown in Table 1-1. This table also shows the Best Value Performance Indicator (BVPI) for Darlington. This has placed an emphasis on recycling and composting in order to achieve the recovery targets of Waste Strategy 2000 and the early diversion requirements of the EU Landfill Directive. In 2004/05 Darlington recycled and composted 17.5% of its household waste and therefore must increase the amount of recycling by 0.5% in the next year to achieve its BVPI recycling target of 18% in 2005/06.

Table 1-1: Recycling targets for Darlington

	Recycling Target			
	Recycling rate achieved 2004/05	**2005/06**	**2010/11**	**2015/16**
Waste Strategy 2000		25%	30%	33%
BVPI targets for Darlington	17.5%	18%		

It is not clear how BVPI targets will change in the future, however, it is likely that these will become more stringent in future years.

Recovery Targets

To encourage more efficient use of resources and to obtain value from waste, the Government has set targets for waste recovery via recycling, composting, energy recovery and other methods such as anaerobic digestion.

- To recover at least 40% of household waste by 2005
- To recover at least 45% of household waste by 2010
- To recover at least 67% of household waste by 2015

It is perceived that it will be difficult to achieve the recovery targets through recycling alone and some form of energy recovery via incineration, gasification or pyrolysis will be required.

Regional Self Sufficiency

Regional Self Sufficiency requires that most waste should be treated or disposed of within the region it is produced. Each region is expected to provide sufficient facilities and services to manage the amount of waste it is expected to produce over the next 10 years. It is recognised that the BPEO for some waste may be to transport it to another region where it can be dealt with more effectively. Not all regions have specialist recovery, recycling or treatment facilities, in line with the proximity principal and economy of scale might apply in such cases.

The Proximity Principle
Waste should generally be managed as close as possible to where it is produced in order to limit the environmental impact of transportation and create a more responsible approach to waste generation.

The Precautionary Principle
When dealing with issues of environmental protection the Government has stated that regard must be given to the Precautionary Principle. This means "*where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation*".

1.3.2 The Landfill Directive

The European Commission has set challenging targets to ensure that the necessary steps towards sustainable waste management are made. The EU Landfill Directive, which came into force on 16th July 2001, is the main driver behind this. The following mandatory targets were introduced to reduce the amount of biodegradable municipal waste going to landfill.

- By 2010* reduce biodegradable municipal waste landfilled to 75% of that produced in 1995.
- By 2013* reduce biodegradable municipal waste landfilled to 50% of that produced in 1995.
- By 2020* reduce biodegradable municipal waste landfilled to 35% of that produced in 1995.

* Includes 4 year derogation

When biodegradable (biowaste) waste decays it gives rise to methane and CO_2, major greenhouse gases, and a liquid leachate that can pollute ground and surface water.

The Landfill Directive requires that landfill sites are classified as hazardous, non-hazardous or inert and effectively ends the co-disposal of hazardous and non-hazardous wastes. It also bans the landfilling of certain wastes such as whole tyres from 2003, and requires that all waste going to landfill will have to be pre-treated to reduce its environment impact. The UK is implementing these targets for BMW through the tradable allowances scheme.

Tradable Allowances

To ensure that local authorities comply with the requirements of the EU Landfill Directive and '*Waste Strategy 2000'*, the Government has introduced a system of tradable allowances for the landfilling of BMW as part of the Waste and Emission Trading Act 2003[1]. Government's Guidance on Trading, Banking and Borrowing Landfill Allowances sets out the procedure for transferring landfill allowances. Authorities can buy more allowances if they expect to landfill more than their allocations and authorities with low landfill rates can sell their surplus allowances. It will also be able to save unused allowances (banking) or bring forward part of their future allocation (borrowing). Any transfer of allowances, through trading or borrowing, will need to be registered on the LATS Register - an online system to record all allowances allocated to each waste disposal authority and to facilitate the banking, borrowing and trading of allowances.

[1] Waste and Emissions Trading Act 2003, ISBN 0 10 543303 9

An allocation of the amount of BMW that can be landfilled each year from 2005/06 to 2019/20 has been provided to Darlington and these are shown in Figure 1-1.

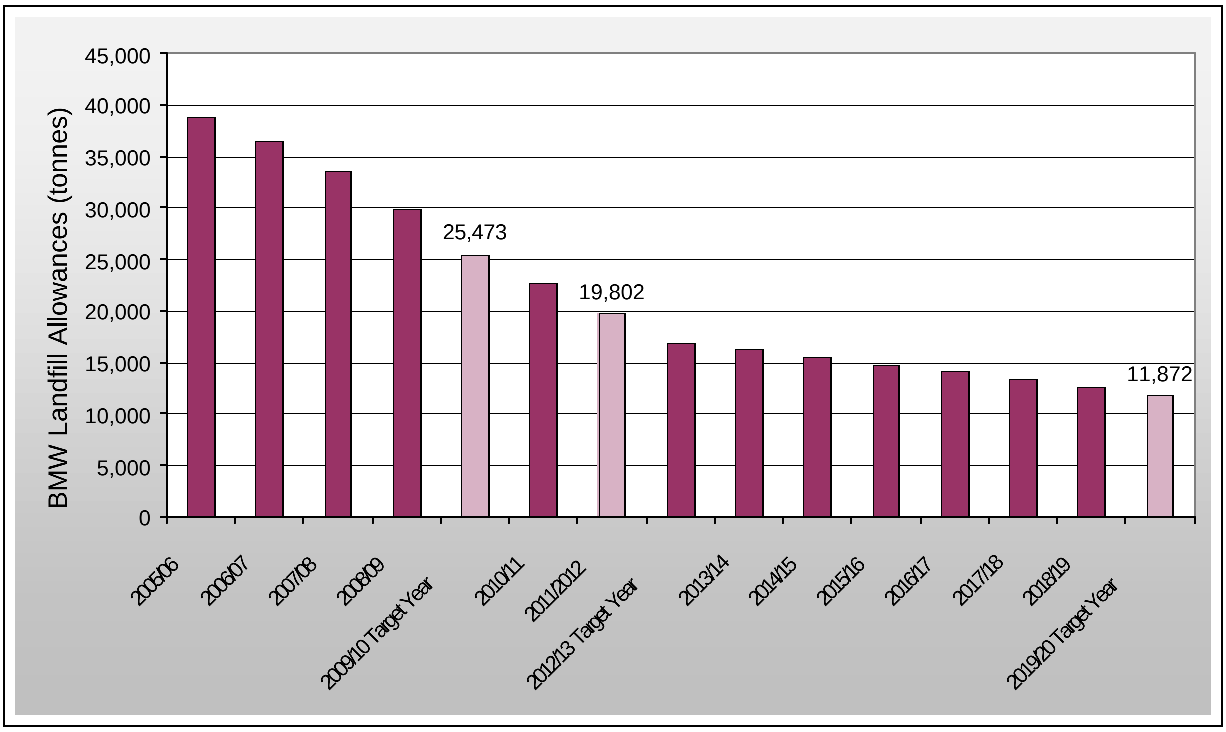


Figure 1-1: Landfill allowance allocation for Darlington (DEFRA Feb 2005 figures)

Through the flexibilities of trading, banking and borrowing, authorities can develop the most cost-effective strategy for meeting their waste targets, tailored to their specific circumstances. However, disposal authorities that exceed their limit and cannot purchase any allowances will be fined £150 for every tonne they are over the limit. The implication of this is that most authorities will plan to meet these targets and therefore trading is likely to be minimal in the longer term. However, in the short term there may be potential for a market whilst infrastructure for waste treatment is developed.

1.4 LANDFILL TAX

In October 1996 the Government introduced landfill tax to discourage the disposal of waste and encourage more recovery and recycling. Table 1-2 shows the increases from 2004/05 until 2011/12 for active waste. The rate of £2/tonne for inert, inactive waste has remained constant. The date for achieving this £35 tax level is dependent on future budget statements but will be achieved by at least 2011/12.

Table 1-2: Past and predicted changes to the Landfill Tax

Time period	Tax per tonne (active waste)
2004/5	£15
2005/6	£18
2011/12[2]	£35

[2] The Chancellor announced in his 2002 pre-budget speech that landfill tax would increase by £3/t in 2005/6 and at least that amount in subsequent years until the tax rose to £35

Though the landfill tax will encourage more sustainable waste management practices it means that local authorities will have real increases in the cost of waste management for the foreseeable future. The Chancellor has announced that landfill tax levels will increase by at least £3/tonne each year until the tax reaches £35/tonne.

1.5 OTHER LEGISLATION INVOLVED IN THE DRIVE TOWARDS SUSTAINABLE WASTE MANAGEMENT

- **The Environmental Protection Act 1990 and Controlled Waste Regulations 1992.** This legislation places a duty on local authorities to manage specified wastes. It regulates waste management and defines how waste should be dealt with.

- **Animal by-products Regulations 2003 SI1482** Provides requirements on the treatment and processing of wastes that come under the definition of catering waste. This definition includes kitchen wastes from households and therefore applies to processing of household waste unless it can be demonstrated to be uncontaminated by kitchen waste. The regulations impose strict handling and processing conditions as well as requirements for the testing and logging of operations. This regulation will principally apply to composting and anaerobic digestion processes including MBT systems.

- **EU Directive on Waste 75/442/EEC (amended by 91/156/EEC and 91/692/EEC) Articles 3,4 and 5.** Requires the consideration of waste minimisation, recycling and energy recovery as well as the need to protect human health and the environment from potentially polluting developments.

- **Producer Responsibility Obligations (Packaging Waste) Regulations 1997 and Packaging (Essential Requirements) Regulations 1998**. Sets targets for those involved in the packaging chain, from raw material production and retailer selling, to recovery and recycling of packaging waste. Whilst this does not apply to local authorities directly, the industry may be encouraged to form strategic partnerships to facilitate the collection and recycling or recovery of packaging waste from the household waste stream.

- **Waste Electrical and Electronic Equipment Directive (WEEE)**. This Directive is still under consultation, and it should have been implemented in the UK by 13 August 2004. The Directive places requirements on manufacturers to collect and recycle waste electrical and electronic equipment. One consequence of this is that local authorities may be required to provide facilities at household waste recycling sites to collect these items from householders. The actual collection targets and the recycling/recovery targets are to be introduced by the 31 December 2004. The Member States are required to collect 4kg of electrical and electronic equipment per head of population per year. The recycling and recovery targets vary according to the material category.

- **End-of-Life Vehicles (ELVs) Directive 2000/53/EC.** The End-of-Life Vehicles (ELVs) Directive will require treatment by authorised dismantlers and shredders. This Directive will have impacts on the disposal of ELVs and is likely to increase the level of abandoned vehicles and the costs involved, by the Councils dealing with them. The Directive was partly transposed into national law on 03 November 2003. The implemented part of the new regulation apply new standards to existing sites, require operators working under a registered exemption to apply for a site licence (if accepting vehicles which have not been depolluted) and set new minimum technical standards for all sites that store or treat ELVs. Other parts of the Directive are still under consultation according to the Department of Trade and Industry including the recycling/recovery targets and the arrangements for the take back of ELVs.

- **Batteries and Accumulators Directive.**
  This will require separate collection and recycling of all batteries across the EU, harmonising very different schemes across the continent. This is likely to result in the County and District Councils having to provide separate collection facilities for batteries, most likely sited at household waste recycling sites.

- **Household Waste Recycling Act 2003**
  The aim of the Act is to assist local authorities in their design and implementation of waste strategies to increase the recycling rate of household waste. The Act provides that where English waste collection authorities have a general duty to collect waste they should ensure that by 31 December 2010 they provide a kerbside collection of at least two types of recyclable waste separate from the rest of the household waste.

- **Biowaste Directive**
  The Biowaste Directive has been scrapped though it is intended to be included within the Communication on the Thematic Strategy for Soil Protection. This was scheduled to be published in the autumn 2004 but has now been delayed. The Biowaste section is currently yet to be published. From the European Commissions Discussion on Sludge Biowaste draft document (Jan 2004) and subsequent discussion meetings, various key issues to consider in the forthcoming legislation have been identified. It is stressed that these views are not necessarily the commission's views. One proposal that could affect local authorities is the potential for mandatory separate collection of biowaste.

- **A Practical Guide for the Development of Municipal Waste Management Strategies**
  In November 2005, the Government published its guidance on municipal waste strategies. The guidance is not intended to be prescriptive but is designed to assist local authorities develop their waste strategy, by providing a source of practical guidance and a logical overall approach to producing a strategy.

2 Current Waste Management in Darlington

This chapter provides a baseline for the study, presenting information on arrangements for waste collection and disposal and the volumes of material collected at household waste recycling sites operating in Darlington. Information is provided on the composition of household waste and waste delivered to the household waste recycling centres. Estimations are also made of how the amount of household waste produced in Darlington might increase in the next 20 years.

The tonnages for current waste management performances are derived from information supplied by Darlington Borough Council.

2.1 GEOGRAPHY

Darlington covers an area of 197 sq km , with a population of just under 100,000. The Town of Darlington is the largest settlement with the area surrounding it largely rural. The area has good transport links with Darlington station being on the main East Coast train line and both the A1 and Teesside Airport being within easy reach.

Darlington has been a unitary authority since April 1997 when it assumed the responsibility for all local government services previously provided by Durham County Council and the former Borough Council. It is therefore has responsibility for both waste collection and disposal.

The contract for the disposal of household waste and management of the Household Waste Recycling and Disposal (HWRDs) site is currently head by Premier Waste Management, this contract is due to expire in 2008. Premier Waste Management are the LAWDC for Durham County Council, Darlington also has a 16% share in the company due to, the borough's waste disposal function historically being carried out by Durham County Council.

The boroughs population has fell by 1.5% between 1991 and 2004, (Government Office for the North East) compared to the North East average of a 2.8% fall.

2.2 REFUSE COLLECTION AND DISPOSAL

2.2.1 Refuse collection

Table 2-1 shows the tonnages for municipal waste in 2004/05. The overall amount of household waste (excluding any trade waste collected) produced per household in Darlington in 2004/05 was 1.31 tonnes per household per year. Collection of household residual waste is by black sack collection with no limit per household.

Table 2-1: Municipal waste collected in Darlington in 2003/04

Waste collected	Tonnage
Total household waste (incl. street arisings, clinical and bulky waste)	32,478
Recycling and composting at kerbside, bring sites and HWRDS	9,413
Waste at household waste recycling sites (incl. hardcore)	18,338
Trade waste collected from local businesses	4,536
Total municipal waste	**64,765**

2.2.2 Refuse disposal

All residual household waste currently collected in Darlington is initially transported to the Heighington transfer station, which is 6 miles North West of Darlington city centre. The waste is then bulked up and transported to the Joint Stocks landfill site in Coxhoe, which is 15 miles outside Darlington Borough Council's area. Trade waste is Landfilled separately at a Landfill site in Billingham, Teesside.

2.3 RECYCLING SCHEMES

The status of the recycling operations during 2005/06 is presented here for information. Darlington operates kerbside sorted collection of 5 separate dry recyclable materials as well as collecting recyclates via 18 bring bank schemes and 1 Household Waste Recycling and Disposal site.

2.3.1 Bring bank schemes

Darlington operates schemes for the collection of paper, glass, cans, textiles, and shoes. There are currently 18 bring schemes sites located across Darlington, e.g. at supermarkets, car parks, shopping centres etc. Table 2-2 indicates the tonnage of recyclables collected at those sites in 2004/05.

Table 2-2: Tonnage of recyclables collected from Bring Schemes in Darlington (2004/05)

	Newspaper & magazines	Glass	Mixed cans	Textiles
Sent direct to market	420.85	331.46	6.74	225.26

2.3.2 Kerbside collection schemes

Darlington operates a fortnightly, green box (55ltr) and reusable bag service, for the collection of dry recyclables from the kerbside. Collected materials include paper, magazines, glass bottles and jars, cans, and PET plastic bottles. The green box is collected on the same day as the residual waste. Table 2-4 indicates the tonnages of recyclables collected at the kerbside in Darlington.

Table 2-3: Kerbside collection schemes in Darlington (2004/05)

Waste material collected	Delivery point
Dry recyclates	
• Fortnightly service for 45.000 households. • Green box (55ltr) for cans, plastic bottles, glass and textiles • Paper separately collected.	John Wade Recycling

Table 2-4: Recyclable material collected at kerbside (2004/05) (tonnes)

Paper	Glass	Cans	Plastic	Textile
2,962	1,232	204	100	32

2.3.3 Household Waste Recycling

There is 1 Household Waste Recycling and Disposal Site (HWRDS) in Darlington situated on Mewburn Road, Darlington. Material collected at the HWRDS represents approximately 33.4% of Darlington's total household waste.

2.4 COMPOSITION OF WASTE IN DARLINGTON

Table 2-5 below show the results of a waste analysis survey carried out on Darlington's Kerbside and HWRDS. Figures in Figure 2-1 and Figure 2-2 show graphically the composition of kerbside waste and HWRDS waste respectively.

Table 2-5: Composition of kerbside waste and HWRDS waste in Darlington

	Collected waste (Wt %)	Waste brought to HWRDs (Wt %)
Paper and card	28.0	5.0
Plastic film	4.0	1.6
Dense plastic	6.0	2.4
Textiles	3.0	4.0
Other Combustibles	7.0	28.5
Other non-combustibles	4.2	19.0
Glass	10.0	1.5
Putrescibles	31.0	35.0
Ferrous metal	3.0	1.0
Non-ferrous metal	2.0	1.0
Fines (< 10 mm)	1.8	1.0
Total	**100.0**	**100.0**

Figure 2-1: Estimated composition of kerbside collected waste in Darlington

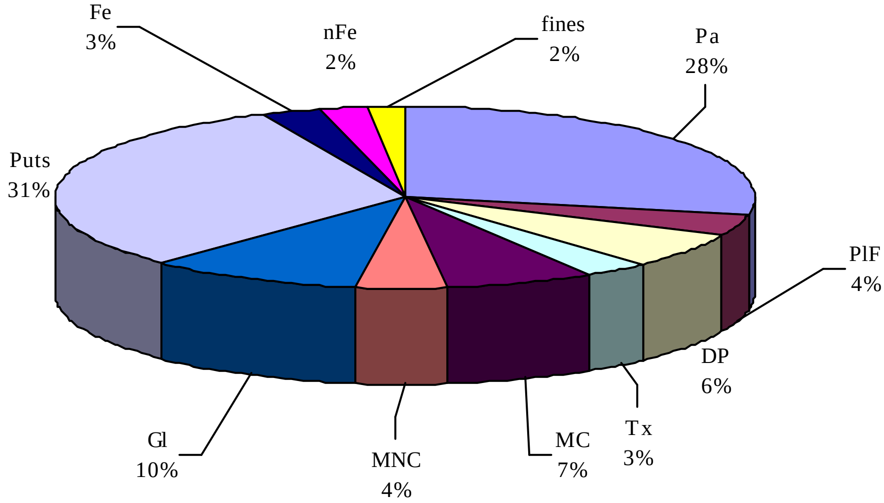
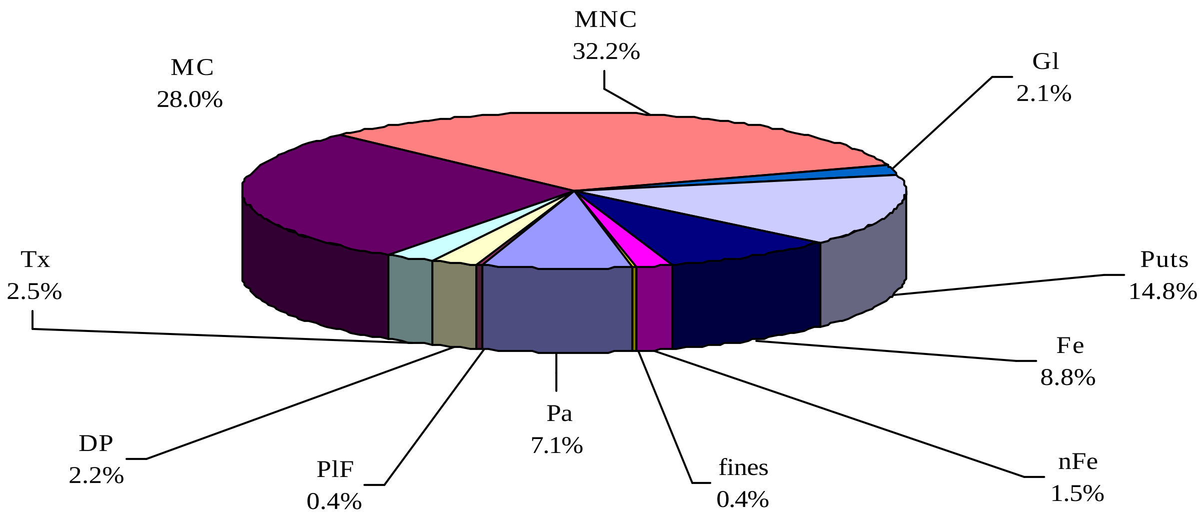


Figure 2-2: Estimated composition of waste collected at the HWRDS



Household collected waste and waste brought to HWRDS represent over 98% of total household waste arisings in Darlington. Consequently, an overall composition for household waste can be calculated using the composition data shown in Table 2-5 and the weight of each refuse stream. The overall composition is shown in Table 2-6.

Table 2-6: Estimated Composition of Household Collected and HWRD Waste Combined in Darlington

	Household waste (Wt %)
Paper and cardboard	17.5
Plastic film	2.8
Dense plastic	4.2
Textiles	3.5
Other Combustibles	22.0
Other non-combustibles	10.1
Glass	6.0
Biowastes	30.0
Ferrous metal	2.0
Non-ferrous metal	1.0
Fines	0.9
Total	**100.0**

Although Table 2-6 shows that 37% of household waste in Darlington is potentially recyclable and that a further 30% is potentially compostable, the actual amount of material that could be recycled will be lower. This is due to two factors; firstly there are currently no markets or uses for some of these materials, and secondly, it is very unlikely that all households will separate all of these materials for recycling. Consequently, in order to increase recycling Darlington will need to educate householders on the need to recycle, provide suitable facilities for collecting the recyclable and compostable materials, and develop markets for all of the materials that are collected.

2.5 PROJECTION OF FUTURE WASTE QUANTITIES

In order to forecast waste growth rate for the future, housing development, trends in waste arisings per household and waste minimisation activities should be considered. The household growth rate is calculated from the projected number of new housing. The growth in waste arisings per household is based on historical trends in waste arisings. Up to 2008 a growth in the number of households and waste arisings is assumed to be 3% (giving a combined growth rate of 6%). Between 2009 and 2014 the combine growth rate is modelled at 4%. Between 2015 and 2020 the modelled growth rate is reduced further to a combined growth rate of 2%. From 2021 to 2034 a growth rate of 1% is used. Table 2-7 shows the annual growth rates for the number of households and waste generation and the overall growth rate. Figure 2-3 shows the effects of the growth rate on the waste generation in Darlington, comparing this to growth rates of 2, 3 and 5%.

Table 2-7: Waste growth rate for the different scenarios

Year	Household Growth Rate (%)	Waste Growth Rate (%)	Overall Waste Growth Rate (%)
2004	3.0	3.0	6.0
2005	3.0	3.0	6.0
2006	3.0	3.0	6.0
2007	3.0	3.0	6.0
2008	3.0	3.0	6.0
2009-2014	2.0	2.0	4.0
2014-2020	1.0	1.0	2.0
2021-2034	1.0	0.0	1.0

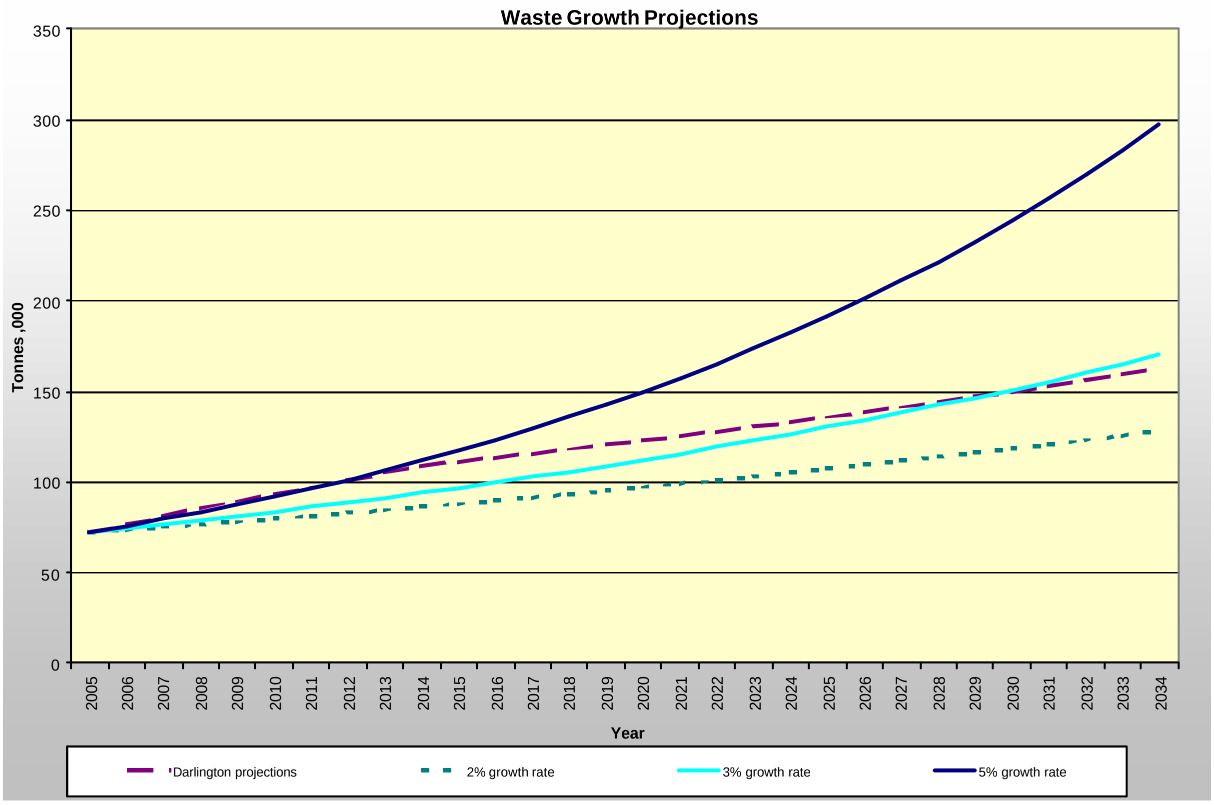


Figure 2-3: Effects of waste growth in Darlington

It can be seen from Figure 2-3 that the growth rate projections for Darlington result in a similar tonnage in 2034 as an annual growth rate of 3%. The graph also shows the affect of a lower growth rate (2%) and a higher growth rate (5%) would have on the waste arisings in Darlington.

3 ASSESSMENT METHODOLOGY AND SCENARIOS

This chapter describes the methodology applied to inform the decision on the most sustainable future scenario(s) for waste management. The scenarios considered for the assessment were developed in consultation with Darlington officers.

3.1 ASSESSMENT METHODOLOGY

The assessment methodology incorporates performance against Waste Strategy 2000 targets, environmental, economic and planning criteria and follows the step-wise approach suggested in WS2000, which states:

"Decisions on waste management, including decision on suitable sites and installations for treatment and disposal, should be based on a local assessment of the Best Practicable Environmental Option."

The BPEO concept was defined in the 12th Report of the Royal Commission on Environmental Pollution as:

"the outcome of a systematic and consultative decision-making procedure which emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefits or the least damage to the environment as a whole, at acceptable cost, in the long term as well as in the short term".

The BPEO concept incorporates two further principles that need to be taken into account when making waste management decisions, and also guides the development of future waste management scenarios:

1. The waste hierarchy
2. The proximity principle

The baseline year for this BPEO assessment is 2015, by which time it is assumed that the majority of infrastructure of each scenario will be established. Therefore, the BPEO has been determined based on the amount of waste forecast to arise in 2015.

The Step-wise Approach to BPEO

The step-wise approach to determining the BPEO as set out in WS2000 and in subsequent guidance[3] is noted below. The following sections of this report outline each step of the BPEO assessment in detail. Step 1 details the criteria against which the future scenarios are assessed. The scenarios for the BPEO assessment are developed in Step 2 and then modelled in Step 3 with the scenario mass flows and associated technologies. These scenarios are ranked and valued in Step 4. The weighting of the criteria and the application of these weightings to the scenarios are carried out in Step 5 giving the outcome of the BPEO assessment. Sensitivity analysis of the BPEO assessment is undertaken in Step 6.

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3 Land Use Consultants and ERM – "Strategic planning for sustainable waste management", Office of the Deputy Prime Minister, http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/pdf/odpm_plan_pdf_606386.pdf

1. Define and agree assessment criteria (Section 3.1.1)
2. Develop strategic waste management scenarios (Section 3.2)
3. Assess strategic waste management scenarios (Sections 3.3 and 3.4)
4. Rank and value performance (Sections 3.5 to 3.8)
5. Weight the indicators (Section 3.8)
6. Sensitivity analysis and scenario refinement (Section 3.8)

3.1.1 Assessment Criteria

The Guidance "Strategic planning for sustainable waste management"[4] recommends 12 objectives with 21 indicators as assessment criteria. These objectives are grouped into three principal assessment categories:

1. Environmental objectives
2. Socio-economic objectives
3. Operational objectives

Furthermore, Darlington has added one additional assessment criteria (proportion of biodegradable municipal waste diverted from landfill) within the operational objectives. Each of the objectives is further defined by a range of indicators, which provide a quantitative or qualitative measure of the performance of the scenario against that objective. The assessment of scenarios combines a number of methods for deriving indicator values including modelling, using specific software tools, and using professional judgement. For the environmental assessment we have made use of the industry standard life cycle assessment tool WISARD[5] as developed and recommended by the Environment Agency. Additionally, for determining performance against targets and costs, we have used AEA Technology's in-house model (WASTEFLOW). Table 3-1 summarises the various appraisal methods.

Table 3-1: Summary of appraisal methods

WISARD	**Generic data & *WASTEFLOW***	**Professional judgement**
• Resource depletion • Greenhouse gas emissions • Emissions that are injurious to public health • Emissions contributing to air acidification • Emissions contributing to depletion of the ozone layer • Emissions contributing to eutrophication	• Landtake • Transport distances • Number of jobs likely to be created • Potential for public involvement and education • Percentage of waste recovered • Percentage of waste recycled • Percentage of BMW diverted • Costs	• Noise, litter and vermin problems • Water pollution • Landscape and visual impacts • Likelihood of implementation within required timescale regarding technology maturity, planning and public involvement

[4] Land Use Consultants and ERM – "Strategic planning for sustainable waste management", Office of the Deputy Prime Minister, http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/pdf/odpm_plan_pdf_606386.pdf
[5] WISARD is the Environment Agency's software tool for assessing the environmental life cycle impacts of waste management options

Environmental Objectives

The environmental objectives and their respective indicators are noted in Table 3-2. Indicator values are either determined from modelling outputs (i.e. WISARD & WASTEFLOW) or a 'performance score'[6] based on professional judgement. Details of the WISARD methodology and output are contained in Appendix 1. To allow modelling of the scenarios specific locations are required to determine distances and the associated transport impacts. The use of specific locations does not prejudice the future use of that site as the sites are selected as exemplar sites that are in an appropriate geographical location. The sites used in the BPEO assessment have been selected from existing facilities and sites owned by Darlington Borough Council. The use in the modelling does not affect any specific planning applications on that specific site or prejudice its current or future use.

Table 3-2: Environmental objectives

Objectives	Indicators
1. To ensure prudent use of land and other resources	Resource depletion (avoided burden in million years) – *WISARD output*
	Landtake (hectares) *(performance score)*
2. To reduce greenhouse gas emissions	Emissions of greenhouse gases (000 tonnes equivalent of CO_2) – *WISARD output*
3. To minimise air quality impacts	Emissions which are injurious to public health (Human Toxicity Index) – *WISARD output*
	Air acidification (tonnes equivalents of H^+) – *WISARD output*
	Ozone depletion (tonnes equivalents of CFC-11) – *WISARD output*
	Extent of odour problems *(performance score)*
	Extent of dust problems *(performance score)*
4. To conserve landscapes and townscapes	Visual and landscape impacts *(performance score)*
5. To protect local amenity	Extent of noise problems *(performance score)*
	Extent of litter and vermin problems *(performance score)*
6. To minimise adverse effects on water quality	Eutrophication (tonnes equivalents of PO_4) – *WISARD output*
	Extent of water pollution *(performance score)*
7. To minimise local transport impacts	Total Transport Distance (thousand kilometres)
	Proportion of non-motorway/non-dual carriageway (%)

Socio-Economic Objectives

The principal objectives and indicators are noted in Table 3-3. An estimate of the number of jobs created to operate the required waste management infrastructure has been made based on the amount of waste likely to be handled and/or processed by the treatment and disposal facilities. The cost of the waste management service can be measured in many ways depending on the time and the elements considered. In this assessment the aggregate cost of the service from 2009 until 2034 has been used. Costs have been determined using the WASTEFLOW model and further details are contained in Appendix 2.

[6] The performance scores are based on professional judgement and reflect aspects that cannot be easily assessed on an objective measurement such as planning issues or risk issues. The methodology for forming the score is detailed in Appendix 1 and 2.

Table 3-3: Socio-economic objectives

Objectives	Indicators
8. To provide local employment opportunities	Number of jobs created (jobs estimated)
9. To provide opportunities for public involvement / education	Potential for participation in recycling and composting (% households with kerbside collection of recyclables)
10. To minimise costs of waste management	Overall costs (£million 2009 - to 2034) – *WASTEFLOW*

Operational Objectives

The two principal criteria of the operational objectives (Table 3-4) are the 'reliability of delivery' and performance against waste policy. The former aims to provide a measure of the degree to which each scenario is proven and deliverable. This takes into account various uncertainties and risks such as gaining permission to develop sites, and the technical difficulty of financing, building and operating the waste management process but also the level of public involvement required. The waste management system must also comply with the various targets for recycling, recovery and landfill diversion. Objective 12 provides a measure of the performance of the various scenarios against these targets.

Table 3-4: Operational objectives

Objectives	Indicators
11. To ensure reliability of delivery	Maturity of technology (performance score)
	Public acceptance/ achievement of planning permission (performance score)
	Public Involvement required (participation rate)
12. To conform with waste policy	Percentage of material recovered (%)
	Percentage of material recycled/composted (%)
	Percentage of BMW diverted from landfill (%)

3.2 DESCRIPTION OF SCENARIOS

The principles of proximity and regional self-sufficiency have been important considerations in developing the scenarios described below. The proximity principle requires that waste be managed as near as possible to its origin. This principle recognises the desire to avoid passing financial and environmental costs onto communities not responsible for the waste generated, whilst reducing the impact of transportation. However, it is clear that it is impractical for all waste to be managed at the actual point of arising, and due consideration needs to be taken of costs, the site and processing capacity availability.

In order to adhere to the principles of self-sufficiency and proximity the scenarios for BPEO assessment have been developed to consider only the MSW arising for which Darlington is responsible. Any consideration of synergies with plans/policies in neighbouring authorities is undertaken only after determining the BPEO for Darlington alone. For the purpose of the modelling a site within Darlington, referred to as X in this report, has been used to determine transport distances.

The following scenarios were modelled as part of the BPEO for Darlington: - .

- **Scenario Base Case – Landfill based**
  No changes to recycling levels (around 23%, excluding any recycling from residual treatment process) and no new facilities introduced. Main disposal route through landfill.

  From 2011

Dry recycling	*Build a transfer facility at site X with onward transport to repressors*
Green waste	*Direct delivery of HWRD site green waste to windrow composting facility 10 km from Darlington*
Residual waste	*Build a transfer station on site X with onward transport to a landfill site 10 km from site X*

- **Scenario 1 - High recycling**
  Waste minimisation activities increased and recycling performance increased up to 40% recycling. Include Biowaste waste (green & kitchen waste) collection using 140 ltr wheeled bin collected fortnightly. In-vessel composting facility for biowaste waste collected. Main disposal route through landfill.

  From 2011

Dry recycling	*Build a transfer facility at site X with onward transport to repressors*
Green waste + Kitchen waste	*Direct delivery of kerbside and HWRD site biowaste waste to in-vessel composting facility at site X*
Residual waste	*Build a transfer station on site X with onward transport to a landfill site 10 km from site X*

- **Scenario 2 - Energy from Waste Facility within Darlington**
  No changes to recycling levels (around 23%, excluding any recycling from residual treatment process). New EfW facility within Darlington taking residual waste.

  From 2011

Dry recycling	*Build a transfer facility at site X with onward transport to repressors*
Green waste	*Direct delivery of HWRD site green waste to windrow composting facility 10 km from Darlington*
Residual waste	*Direct delivery to site X for thermal treatment.*
Treatment residues	*Direct to landfill site 10 km from site X*

- **Scenario 3 - Energy from Waste Facility at a site outside Darlington**
  No changes to recycling levels (around 23%, excluding any recycling from residual treatment process). EfW facility outside Darlington taking residual waste.
  Shall assume a distance and gate fee for 3rd party EfW Facility.

  From 2011

Dry recycling	*Build a transfer facility at site X with onward transport to repressors*
Green waste	*Direct delivery of HWRD site green waste to windrow*

	composting facility 10 km from Darlington
Residual waste	*Direct delivery to site X for bulking and onward travel to EfW (site Y) 60km from site X*
Treatment residues	*Direct to landfill site 10 km from site Y*

- **Scenario 4 - Mechanical Biological Treatment facility within Darlington**
  Increased recycling via biowaste (green & kitchen waste) collection using 140 ltr wheeled bin collected fortnightly. In-vessel composting facility for biowaste collected. New MBT with anaerobic digestion (AD) facility within Darlington taking residual waste and the Refuse Derived Fuel (RDF) going to a 3rd party for combustion.

From 2011

Dry recycling	*Build a transfer facility at site X with onward transport to repressors*
Green waste + Kitchen waste	*Direct delivery of kerbside and HWRD site biowaste to in-vessel composting facility at site X*
Residual waste	*Direct delivery to site X for processing*
RDF product	*Direct delivery to 3rd party 60 km from Site X*
AD Compost/digestate Product	*Direct delivery to landfill site 10 km from Site X*
Treatment residues	*Direct to landfill site 10 km from site X*

- **Scenario 5 - Gasification facility within Darlington**
  No changes to recycling levels (around 23%, excluding any recycling from residual treatment process). New Gasification facility within Darlington taking residual waste.

From 2011

Dry recycling	*Build a transfer facility at site X with onward transport to repressors*
Green waste	*Direct delivery of HWRD site green waste to windrow composting facility 10 km from Darlington*
Residual waste	*Direct delivery to site X for processing*
Treatment residues	*Direct to landfill site 10 km from site X*

- **Scenario 6 - Energy from Waste Incineration within Darlington and increased recycling**
  Increased recycling performance. Include green waste collection using 140 ltr wheeled bin collected fortnightly. New EfW facility within Darlington taking residual waste.

From 2011

Dry recycling	*Build a transfer facility at site X with onward transport to repressors*
Green waste	*Direct delivery of kerbside and HWRD site green waste to windrow composting facility 10 km from Darlington*
Residual waste	*Direct delivery to site X for processing*
Treatment residues	*Direct to landfill site 10 km from site X*

The key variable in the scenarios is the choice of residual treatment facility. The following assumptions were used in the scenarios:

1. *The waste tonnage figures for 2004/05 were supplied by Darlington Borough Council.*
2. *Composition analysis for household waste and household waste recycling centres is based upon the waste composition survey carried out in Darlington in 2005.*
3. *The input parameters of the WASTEFLOW modelling exercise for biodegradability of waste, cost data and energy output and revenue are shown in Table 3-5.*
4. *In all scenarios the existing recycling arrangements continue (kerbside dry recyclables, bring banks and HWRDS).*
5. *In Scenario 1 a higher recycling rate is achieved by the introduction of a kerbside collection of kitchen and garden waste and an improved performance in dry kerbside recycling. Biowaste is taken to an in- vessel composting facility to be processed.*
6. *In Scenario 4 a kerbside collection of kitchen and garden waste is introduced. Biowaste is taken to an in vessel composting facility to be composted.*
7. *In Scenario 6 a higher recycling rate is achieved by the introduction of a kerbside collection of garden waste. Garden waste is taken to a windrow composting facility to be composted.*
8. *Generally, the kerbside collection for dry recyclables will improve continuously. Participation rates are improved through public education and awareness programmes.*
9. *The existing bring network continues to operate with some improvement. New banks are introduced to keep pace with the forecast growth in households and the waste stream.*
10. *Under each scenario except the Base Case and Scenario 3 (EFW outside Darlington) the treatment facility is at a site (X) within Darlington (the same site is used in each scenario).*
11. *Green waste collected from HWDRS will continue to be transferred to the existing windrow composting facilities except in scenario 1 and 4 where all biowaste is taken to an in-vessel composting facility.*
12. *Under each scenario it has been assumed that the treatment facilities for residual waste treatment will start operating in 2011 (this is the minimum time needed to gain planning permission and build the plants). It has also been assumed that existing waste disposal arrangements will be extended up to that time.*

As noted before the sites identified and modelled in the scenarios are only used to determine the distances for the transport impacts and are representative of sites that are in the general geographical area necessary for servicing the population of Darlington. The use of a particular site does not infer any preference for the site in planning terms other than it is compliant with the geographical spread of the BPEO. However, all new uses for sites will require to be assessed under the planning regime and the normal decision criteria on site viability will apply. The sites identified in this report are all sites that are either existing waste management facilities or sites owned by Darlington Borough Council.

Table 3-5: WASTEFLOW model input parameters

BIODEGRADABILITY OF WASTE	
MSW	68%
Active Residues	34%
Dry recyclable materials	60%
COST DATA	
Cost of LATS Penalties	£150/tonne
Value of income from LATS	£40/tonne
Landfill gate fee (active and inactive)*	£21.6/tonne
Landfill tax (active)	Currently £18/t, Increase of £3/year in 2006/07 till ceiling of £35/t reached
Landfill tax (inactive)	£2/t
Windrow composting gate fee	£25/tonne
Discount Rate (%)	6
ENERGY OUTPUT AND REVENUE	
Revenue per KWh	£0.034
KWh per tonne EfW	525
KWh per tonne gasification	525

*Inactive waste is normally the residue from thermal treatment (smaller volume, biologically stable).

In order to allow the modelling of a waste management system a series of treatment and disposal technologies for the recyclables and residual waste have been identified.

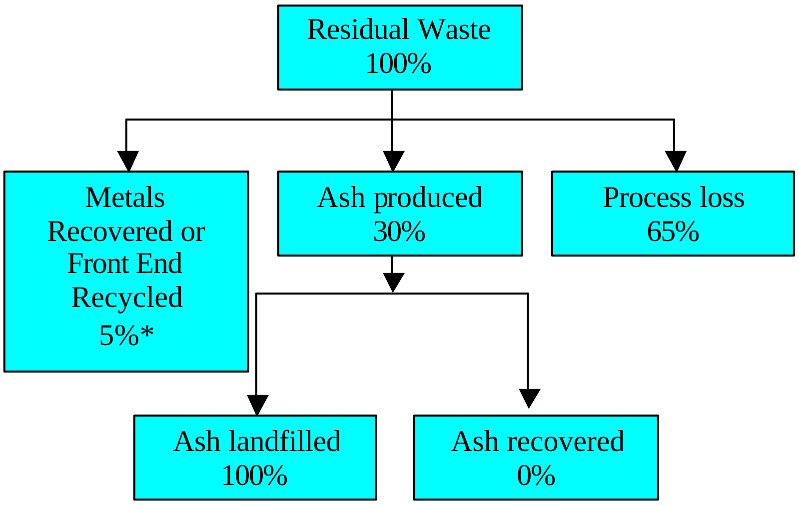
All scenarios:

- Kerbside sorting of dry recyclables collected from the households and transferred via bulking facilities to the market.
- Windrow composting of green waste separated at HWDRS (except Scenario 1 and 4).
- Dry recyclables from HWDRS and bring schemes are delivered directly to the market.

Variations in the choice of disposal technology and their treatment capacities for the different scenarios:

- Energy from waste (EfW) technology for residual waste operational from 2011. Metals can be recovered after incineration (although this does not count as recycling under the BVPI definition). Bottom ash has the potential to be recovered and used as an aggregate though in the scenarios modelled it is assumed all bottom ash is disposed to landfill. Fly ash (about 4% of total waste input) must be landfilled as hazardous waste.
- Gasification of the residual waste, operational from 2011. Metals can be recycled through front end sorting of the residual waste (which counts as recycling under BVPIs). Again the bottom ash produced has the potential to be recovered and used as an aggregate though in the scenario modelled it is assumed all ash residues are disposed to landfill. Fly ash (about 4% of total waste input) must be landfilled as hazardous waste.
- Mechanical biological treatment (MBT) of the residual waste from 2011 with sorting prior to anaerobic digestion (AD) of the biodegradable fraction. Refuse derived fuel (RDF) can be sent to a 3rd party as a fuel, sent for combustion to an on site combustion plant or disposed to landfill (depending on the market for the RDF). In the scenario modelled it is assumed that the RDF product is sold to a 3rd party. It is assumed in the BPEO assessment that the compost/digestate product from AD cannot be utilised and has to be landfilled.

Thermal treatment processes is a reference to a group of technologies that combust waste. These include mass burn energy from waste (EfW) technology and advanced thermal treatment technologies such as gasification/pyrolysis. It should be considered that gasification/pyrolysis requires pre-treatment of the residual waste. Depending on the type of thermal treatment technology adopted different mass flows result for the processing of waste that can count towards recycling and recovery targets. Figure 3-1 outlines the mass flow of the thermal treatment recovery process.



*For mass burn incineration the 5% is metals recovered and qualifies towards recovery targets. For Gasification/pyrolysis technologies the 5% is apportioned to front end recycling/pre-treatment and qualifies towards recycling targets.

Figure 3-1: Schematic of thermal treatment process

MBT "technology" is a reference to a group of proprietary technologies that utilise a combination of mechanical and manual sorting and/or biological treatment (in-vessel composting or anaerobic digestion) in various arrangements that essentially generate a range of products including metals and mineral fractions for recycling, compost products or growing media, refuse derived fuel (RDF) and a residual reject fraction for landfill. There are many different processes that fulfil these requirements and the proportions of products vary from those that generate the greatest proportion of RDF to those that produce a greater proportion of compost. The exact choice of technology will be decided by what the waste industry offers to Darlington Borough Council under any future tendering process. In this BPEO assessment we have assumed anaerobic digestion composting of the biowaste fraction as biological treatment. Figure 3-2 outlines the mass flow of the modelled MBT process which shows that 22% of the waste is turned into a compost/digestate, which is landfilled.

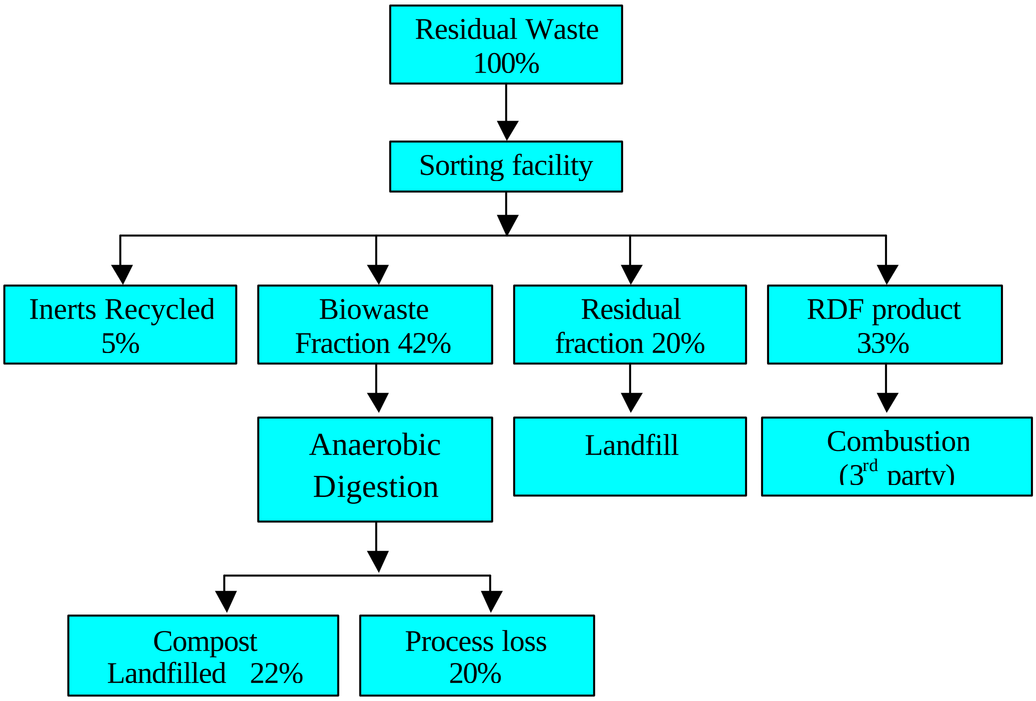


Figure 3-2: Schematic of MBT Process with in-vessel composting of biowaste fraction (process modelled in BPEO)

On-site or off-site use of RDF – There are two options for the utilisation of the fuel product (RDF). The RDF can either be used on-site in an EfW or gasification /pyrolysis plant or it can be transported off-site to a third party user e.g. cement kilns, power stations or dedicated waste treatment facilities. If no market for the RDF can be identified, it will be landfilled as residual waste. In the BPEO analysis it is assumed that the RDF products have been sent to a third party, who are lilkey to charge a gate fee for reprocessing the RDF.

3.3 SCENARIO MASS FLOWS

All scenarios are modelled following this mass flow based on the projected tonnages (shown in Table 3-7) for each scenario. The estimates of tonnages of recyclables collected from the bring network, kerbside collections and operations at household waste recycling sites have been derived from AEA Technology's WASTEFLOW model. The tonnage of recyclables collected and residual waste remaining for further treatment allow for the determination of processing or treatment facility capacities, and hence the determination of capital and operational costs. The capacities modelled are sufficient to meet needed capacity given predicted flows of MSW in Darlington. The facilities have approximately 30-35 ktpa of spare capacity in 2015 that might be exploited through additional processing of commercial & industrial waste at the same sites, as shown in Table 3-6. Given that some commercial & industrial waste is of similar composition to MSW it can often be processed through the same facilities as MSW. However, due to waste growth this spare capacity will be used for municipal waste from Darlington by 2034.

Table 3-6 Capacity of Treatment Facilities

Scenario	2015 Capacity Requirement	2034 total capacity of facility
Scenario 2 & 5	76,000 tonnes	110,000 tonnes
Scenario 4	65,000 tonnes	95,000 tonnes
Scenario 6	70,000 tonnes	100,000 tonnes

Table 3-7 shows, for each scenario, the capacity required in Darlington for each type of processing facility in 2015.

Table 3-7: Processing and treatment capacities (2015)

Facility	Base Case	Sc1 Maximised waste minimisation and high recycling	Sc 2 EfW In Darlington	Sc 3 EfW outside Darlington	Sc 4 MBT in Darlington	Sc 5 Gasification in Darlington	Sc 6 EfW in Darlington with increased recycling
Total waste arising	111,281	109,109	111,281	111,281	111,281	111,281	111,281
Bulking facility	7,406	11,363	7,406	7,406	7,406	7,406	7,406
Transfer Station	74,504	57,816	-	74,504	-	-	-
Garden waste composting (windrow)	5,915	-	5,915	5,915	-	5,915	11,090
Biowaste composting (IVC)	-	16,933	-	-	17,270	-	-
EfW	-	-	76,261	76,261	-	-	71,346
Gasification	-	-	-	-	-	76,261	-
MBT	-	-	-	-	65,474	-	-
Residues + unprocessed waste to landfill (active)	86,060	70,260	9,799	9,799	37,866	9,799	10,058
Processed residues to landfill (inactive)	-	-	22,878	22,878	-	22,878	21,404

The specific types of processing plant considered within these scenarios have been fixed to allow modelling but within the generic technology types there are many options and the ultimate choice will be made at the time of tendering of the waste contracts.

3.4 MODELLING OUTPUT

Modelling of the waste management scenarios has been carried out using AEA Technology's WASTEFLOW model to predict the performance and costs. The details of this modelling are discussed in Appendix 2 but are summarised here in the main text for clarity.

3.4.1 Recycling performance

All scenarios (except Scenario 1, 4 and 6) were modelled to achieve above the 18% BVPI target for recycling, through kerbside collection of dry recyclables, bring schemes and recycling at HWRD sites. Scenario 1 and were 4 were modelled to increase recycling through the collection of kitchen and garden waste. Scenario 6 was modelled to increase recycling through the collection of garden waste. Scenario 1 (High recycling) has the highest recycling rate of all of the scenarios as shown in Figure 3-3.

Scenario 4 (MBT-AD) almost reaches the 40% recycling mark due to the collection of biowaste and the additional recycling achieved via the MBT-AD technology. The Gasification scenario (5) shows slightly higher recycling levels than the EfW scenarios, because the metals are separated before gasification and can count towards the recycling performance. All the scenarios achieve well in excess of the 18% target.

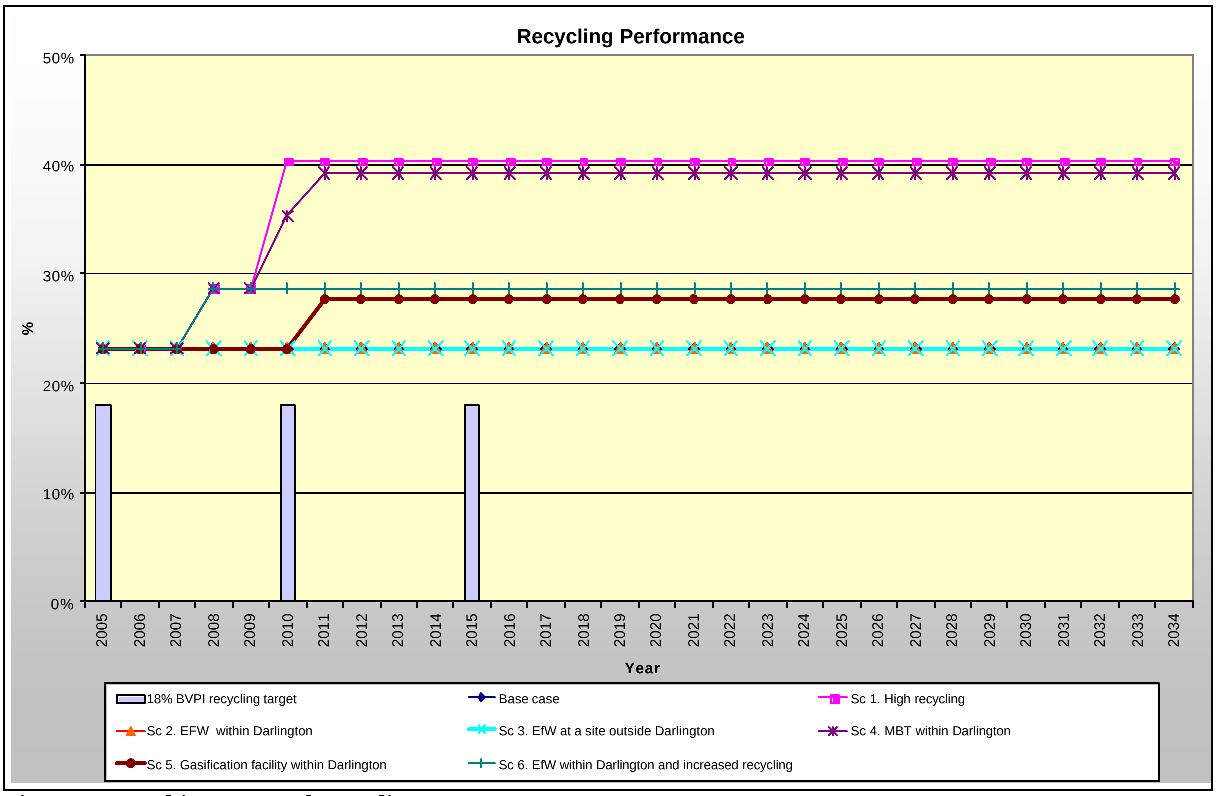


Figure 3-3: Achievement of recycling targets

3.4.2 Landfill Directive targets

The Landfill Directive will impose demanding requirements to limit the amount of biodegradable municipal waste (BMW) being landfilled in the UK. The Government has implemented this Directive by issuing allowances to landfill BMW, which can be traded between local authorities. Darlington has been allocated reducing annual allowances from 2005 - 2020. Figure 3-4 shows the allocated amount allowed for landfilling for each year (area shaded in blue).

Figure 3-4 shows that when the treatment processing technologies such as EfW, and gasification are adopted in 2011 the diversion rates of BMW from landfill are within the allocation of LATS. Between these two technologies there is little variation in their performance with regards to BMW diversion.

Although MBT technologies can be used to treat all the residual waste, the technologies performance against LATs is not as good as EfW or gasification. This is due to the Environment Agency guidance, which makes it likely that compost produced by MBT facilities will have to be landfilled and not utilised. As the compost produced will still be biodegradable (although the biodegradable proportion will have reduced) any remaining biodegradable content will count against LATs targets. The modelling assumes a 50% reduction in biodegradability (from 68 to 34%) based on Environment Agency guidance. If the performance of the MBT system could reduce this further, the gap between LATS allowances and the actual amount of biodegradable waste would be reduced thus negating the need to buy as many permits.

Figure 3-4 indicates that prior to the introduction of residual treatment in 2011 there will be a need for purchasing landfill allowances.

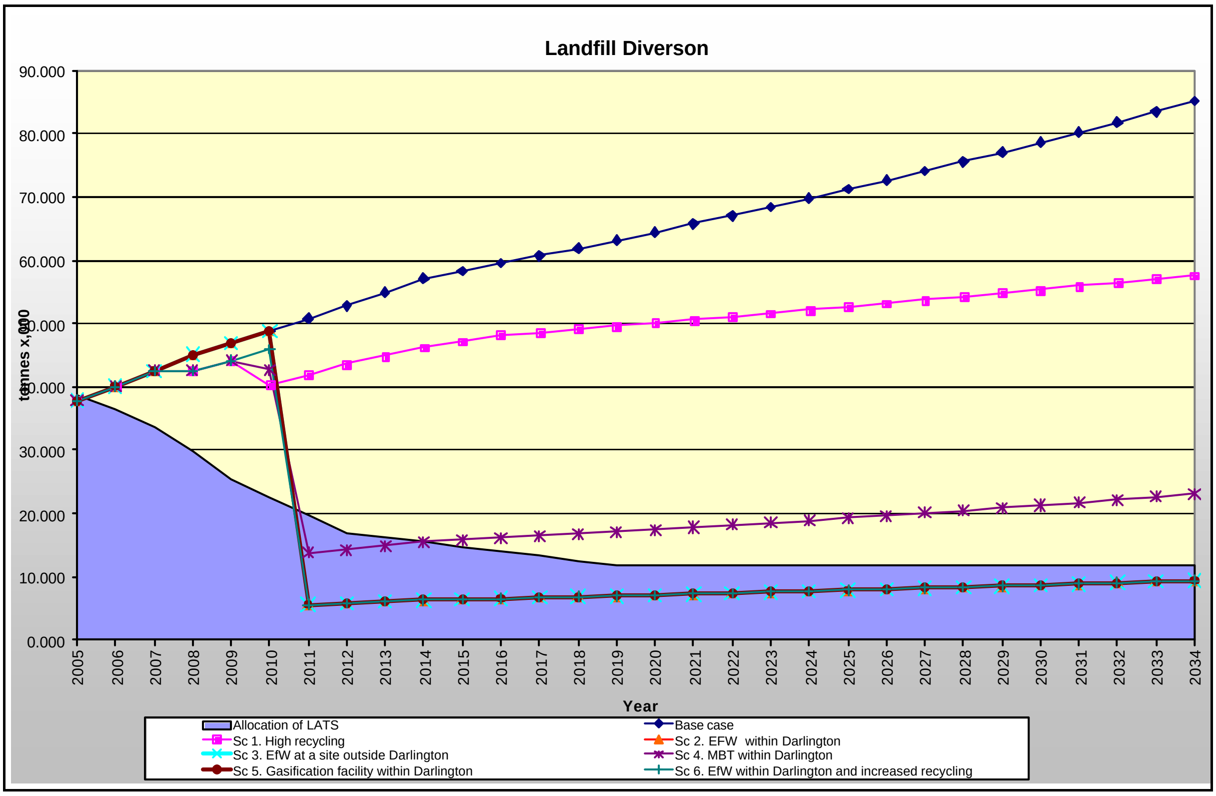


Figure 3-4: Progress to meeting Landfill Directive BMW diversion targets BMW

3.4.3 Costs

Figure 3-5 shows, the total annual cost profile for each scenario including bulk collection and disposal. However, it should be noted that these costs do not include the costs for the educational support programmes to achieve the higher recycling levels at the kerbside by 2011.

Scenarios 2 (EfW within Darlington), Scenario 3 (EfW outside Darlington) and Scenario 6 (EfW within Darlington with increased recycling) have all come out at similar costs. Scenario 2 is slightly cheaper than Scenario 3 due to Scenario 3 having a high 3rd party EfW gate fee and additional transport costs. It is evident that given the scale of EfW plant required it is a fine balance between having a facility within Darlington and utilising a 3rd party outside, with the main influence being the reduced cost of a 3rd party EfW against the additional transport requirements.

The costs for gasification within Darlington are slightly higher than for EfW. It has to be considered that gasification is a new technology not yet established in the UK with large treatment capacities for residual waste. Thus, there is an uncertainty in allocating costs for such technologies and the technical risk element needs to be considered carefully within the costs. However, due to the relatively small capacity of 110ktpa pyrolysis/gasification may be competitive to conventional thermal treatment.

MBT-AD (Scenario 4) shows higher costs than the thermal treatment technologies partly due to the requirement of purchasing LATs permits (modelled at &150 per tonne).

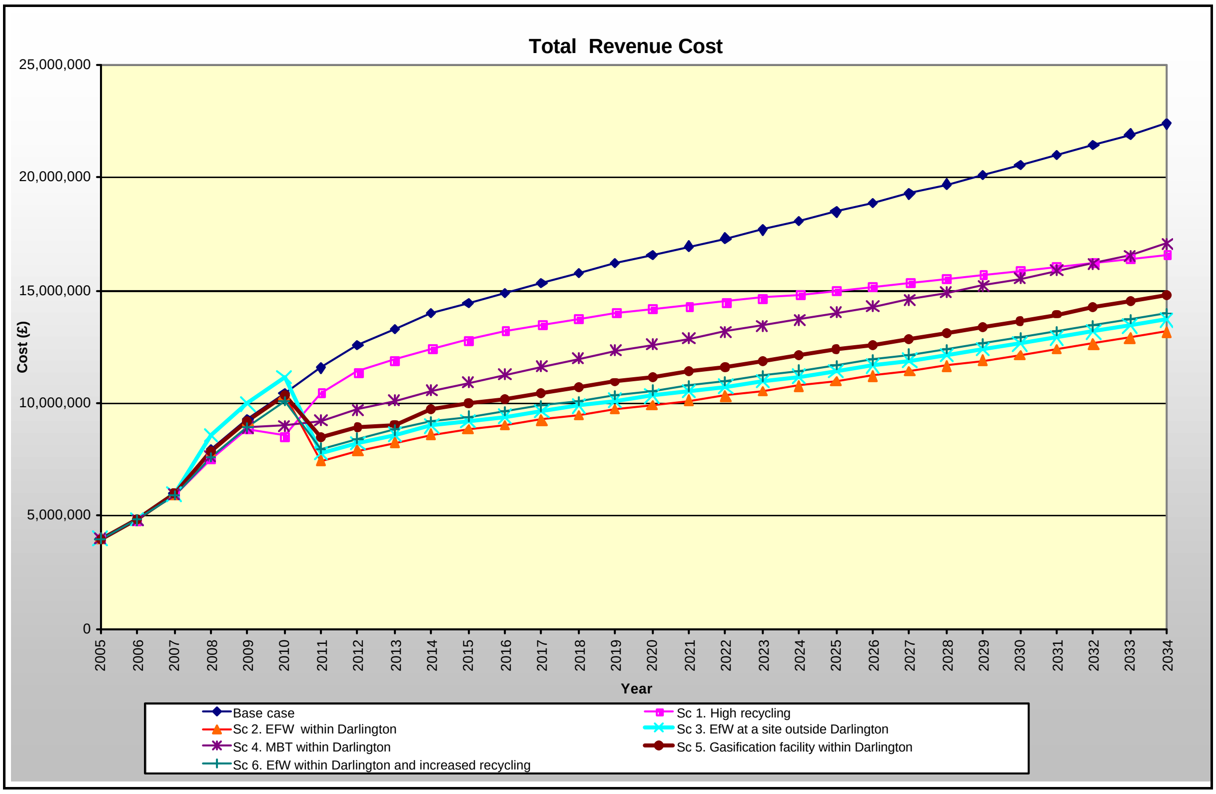


Figure 3-5: Cost projection

The Base Case and Scenario 1 (High recycling) have the highest costs as there is a need to purchase LATs permits. Scenario 1 becomes less expensive than Scenario 4 around the year 2032 due to waste minimisation initiatives reducing the amount of waste being produced in Scenario 1. Within the modelling we have assumed £150 per tonne for such permits to be purchased or £40 per tonne income in scenarios where Darlington has a surplus of permits to sell. However the actual vale for these may differ to that value modelled, depending on market demand.

3.5 SUSTAINABILITY ASSESSMENT

This section presents the outputs of the WISARD (environmental) and WASTEFLOW (costs and performance against targets) modelling assessments. The actual numerical values from the modelling assessment are presented. In order to 'value' the performance of the evaluated criteria, the criteria scores can be converted to a value score by allocating a score between 0 (worst performing) and 1 (best performing). Figure 3-6 illustrates the process of converting the criterion score to a values score[7].

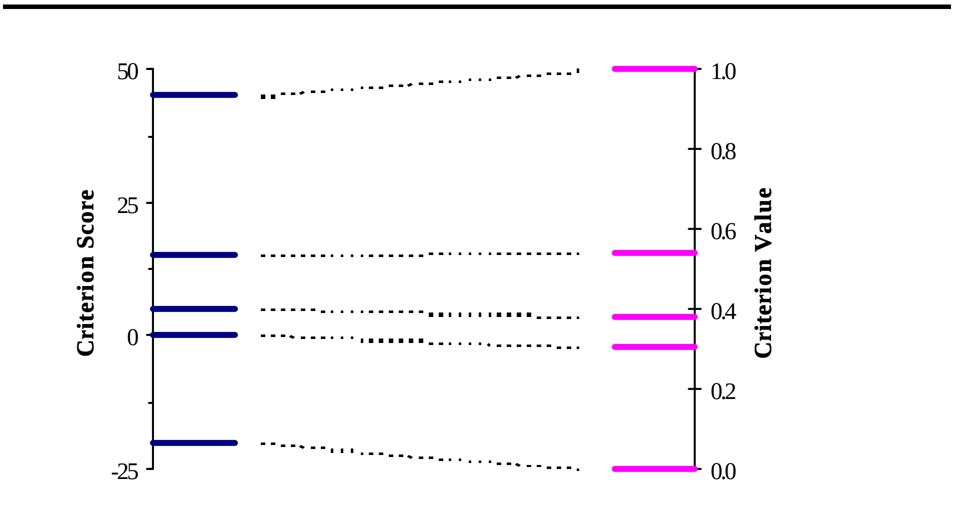


Figure 3-6: Illustration of normalising criterion scores

The conversion of the criterion score to a normalised criterion value score allows the various scenarios to be compared. By summing the normalised criterion value scores to give a total valued score the various scenarios can be ranked according to performance.

A valued performance score, and a ranking of scenarios, has been determined for each of the three principal objectives. The results of the valued performance are discussed in the following Sections:

- Environmental objectives (Section 3.5.1)

[7] For a set of 'n' scores x1 to xn, the normalised value yi of xi is given by: $y_i = \frac{x_i - Min[x_1, x_2, ... x_n]}{Max[x_1, x_2, ... x_n] - Min[x_1, x_2, ... x_n]}$

This formula sets the highest value at one, the lowest at zero, and the rest in a relative position between one and zero. If the highest value actually represents the worst option, the numbers must be inverted, as follows:

$$y_i = 1 - \frac{x_i - Min[x_1, x_2, ... x_n]}{Max[x_1, x_2, ... x_n] - Min[x_1, x_2, ... x_n]}$$

- Socio-economic objectives (Section 3.6.)
- Operational objectives (Section 3.7)

The scores of the normalised values for each criterion are then weighted to assess the relative importance of indicators (see Section 3.8.). The weighting factors used for the BPEO assessment for Darlington were derived as an average from the weighting factors set by the Officers from Darlington Borough Council.

3.5.1 Environmental objectives

The detailed analysis of the environmental criteria is given in Appendix 1. This Appendix provides a discussion of the observed trends and outlines how the environmental assessment has been performed using the Environment Agency's WISARD life cycle assessment tool and other in house tools for parameters not covered by WISARD.

Table 3-8 collates the results of the modelling assessment for environmental objectives. Direct use of the results contained in Table 3-8 to confirm overall performance is difficult because of the complexity of the matrix and the different units used. By normalising the criterion scores to a numerical or value score the matrix is simplified and the performance against criteria is placed on a common scale, whilst still retaining the cardinal nature of the original data. In Table 3-9 the original outputs of Table 3-8 have been normalised to give the normalised performance scores for each scenario. The final row of Table 3-9 sums the normalised performance scores for each scenario. This provides a simple overall measure of the performance of the scenarios and allows them to be ranked so the best performing scenario can be identified[8].

On the basis of environmental objectives alone and equal weighting of the parameters it is seen that Scenario 5 (gasification in Darlington) performs best. This is mainly due to the lower levels of harmful emissions and higher energy recovery rates than other treatment technologies. Gasification is however a new technology with little operational experience in the UK for large scale residual waste treatment and this fact needs to be balanced against the better environmental performance.

All the scenarios modelled (except the Base Case) benefit from the diversion of biodegradable waste from landfill to varying degrees. However, in the WISARD analysis thermal treatment benefit from the additional energy production and offsetting of other fuels. WISARD assumes that additional electricity generation replaces coal-fired electricity as the older less efficient facilities are replaced first. In the longer term other power plants will be replaced and a mixture of coal, oil and nuclear will be decommissioned. However, coal will dominate this mixture for many years to come. In summary, the additional electricity generation provides the largest benefits for the thermal treatment scenarios.

Scenario 4 (MBT-AD in Darlington) performs poorly, because it has been assumed that the compost produced is landfilled. The environmental performance of MBT would improve if a suitable outlet could be found for this material to be used beneficially. The scenario also suffers from requiring a larger landtake than other scenarios due to the utilisation of a MBT facility and an IVC, which in turn causes added environmental problems, such as litter, dust and noise. Scenario 4 does provides an additional benefit of energy recovery from the MBT-AD but it is less than the thermal technologies.

[8] The scenario, which scores the highest, is best performing. The results should not be regarded as a precise overall measure of performance; the two decimal places are retained only for consistency.

Table 3-8: Environmental objectives – performance of scenarios

Objectives	Criterion	Base Case	Sc 1. High recycling	Sc 2. EfW within Darlington	Sc 3. EFW outside Darlington	Sc 4. MBT-AD within Darlington	Sc 5. Gasification within Darlington	Sc 6. EfW within Darlington and increased recycling
1. To ensure prudent use of land and other resources	Resource depletion (avoided burden in million years) – W*ISARD output*	-0.19	-0.30	-1.88	-1.87	-0.83	-1.89	-1.88
	Landtake (hectares) *(performance score)*	3.13	3.85	4.31	3.81	6.69	4.31	5.51
2. To reduce greenhouse gas emissions	Emissions of greenhouse gases ('000 tonnes equivalent of CO_2) – *WISARD output*	9.4	10.4	11.4	12.4	13.4	14.4	-33
3. To minimise air quality impacts	Emissions which are injurious to public health (Human Toxicity Index) – *WISARD output*	-160.09	-201.82	-446.58	-442.45	-296.00	-553.38	-1,137.40
	Air acidification (tonnes equivalents of H^+) – *WISARD output*	-4.09	-5.13	-10.70	-10.60	-7.13	-13.67	-28
	Ozone depletion (tonnes equivalents of CFC-11) – W*ISARD output*	-22.38	-32.23	-43.48	-43.90	-34.93	-45.26	-168.7
	Extent of odour problems *(performance score)*	11.00	9.00	10.00	10.50	10.50	10.00	40.8
	Extent of dust problems *(performance score)*	8.50	6.50	7.00	7.00	7.50	7.00	24.8
4. To conserve landscapes and townscapes	Visual and landscape impacts *(performance score)*	8.00	9.00	11.00	9.50	12.00	11.00	40.9
5. To protect local amenity	Extent of noise problems *(performance score)*	8.00	7.00	8.00	8.00	8.50	8.00	29.4
	Extent of litter and vermin problems *(performance score)*	10.00	9.00	9.00	9.50	9.50	9.00	37.5
6. To minimise adverse effects on water quality	Eutrophication (tonnes equivalents of PO_4) – WISARD output	42.69	85.14	5.13	5.13	97.30	5.10	153.1
	Extent of water pollution *(performance score)*	6.50	6.50	7.00	6.50	8.50	7.00	21.6
7. To minimise local transport impacts	Total Transport Distance (thousand kilometres)	1,100.68	1,184.74	1,059.95	1,280.07	1,210.83	1,066.47	5,292.40
	Proportion of non-motorway/non-dual carriageway (%)	72.74	67.44	71.19	74.41	68.11	71.31	0.7

Table 3-9: Environmental objectives – value performance[9]

Objectives	Criterion	Base Case	Sc 1. High recycling	Sc 2. EfW within Darlington	Sc 3. EFW outside Darlington	Sc 4. MBT-AD within Darlington	Sc 5. Gasification within Darlington	Sc 6. EfW within Darlington and increased recycling
1. To ensure prudent use of land and other resources	Resource depletion (avoided burden in million years) – W*ISARD output*	0.00	0.06	0.99	0.99	0.38	1.00	1.00
	Landtake (hectares) *(performance score)*	1.00	0.80	0.67	0.81	0.00	0.67	0.33
2. To reduce greenhouse gas emissions	Emissions of greenhouse gases (000 tonnes equivalent of CO_2) – *WISARD output*	0.00	0.17	0.76	0.75	0.64	1.00	0.76
3. To minimise air quality impacts	Emissions which are injurious to public health (Human Toxicity Index) – *WISARD output*	0.00	0.11	0.73	0.72	0.35	1.00	0.71
	Air acidification (tonnes equivalents of H^+) – *WISARD output*	0.00	0.11	0.69	0.68	0.32	1.00	0.68
	Ozone depletion (tonnes equivalents of CFC-11) – W*ISARD output*	0.00	0.43	0.92	0.94	0.55	1.00	0.90
	Extent of odour problems *(performance score)*	0.00	1.00	0.50	0.25	0.25	0.50	0.50
	Extent of dust problems *(performance score)*	0.00	1.00	0.75	0.75	0.50	0.75	0.75
4. To conserve landscapes and townscapes	Visual and landscape impacts *(performance score)*	1.00	0.75	0.25	0.63	0.00	0.25	0.25
5. To protect local amenity	Extent of noise problems *(performance score)*	0.33	1.00	0.33	0.33	0.00	0.33	0.33
	Extent of litter and vermin problems *(performance score)*	0.00	1.00	1.00	0.50	0.50	1.00	1.00
6. To minimise adverse effects on water quality	Eutrophication (million grams equivalents of PO_4) – WISARD output	0.59	0.13	1.00	1.00	0.00	1.00	1.00
	Extent of water pollution *(performance score)*	1.00	1.00	0.75	1.00	0.00	0.75	0.75
7. To minimise local transport impacts	Total Transport Distance (thousand kilometres)	0.81	0.43	1.00	0.00	0.31	0.97	0.74
	Proportion of non-motorway/non-dual carriageway (%)	0.24	1.00	0.46	0.00	0.90	0.45	0.36
TOTAL		**4.98**	**8.99**	**10.81**	**9.35**	**4.69**	**11.67**	**10.06**
Rank		**6**	**5**	**2**	**4**	**7**	**1**	**3**

[9] The scenario, which scores the highest, is best performing. A rank of 1 shows the best performing scenario, a rank of 7 shows the worst performing scenario. The results should not be regarded as a precise overall measure of performance; the two decimal places are retained only for consistency.

3.6 SOCIO-ECONOMIC OBJECTIVES

The detail of the socio-economic criteria and assessments are provided in Appendix 2. The overall outputs of the assessment of socio-economic objectives are listed in Table 3-10 and the normalised value scores in Table 3-11.

The potential for participating in recycling and composting are assumed to be the same for the Base Case and Scenarios 2, 3 and 5 as the same level of kerbside collection service is provided. Scenarios 1, 4 and 6 have higher potential for participation due to the additional biowaste or green waste collections.

The estimated number of jobs varies between 61 jobs in the Base Case to 97 jobs in Scenario 4 (MBT-AD). Generally, scenarios requiring some kind of mechanical separation, collection of kitchen waste or provision of a transfer station score higher in the number of jobs. Scenario 4 delivers the highest employment opportunity, because of the MBT-AD facility and the increased collection requirements for a kitchen waste collection.

The costs for waste management are shown as cumulative cost from 2009 to 2034 (see Figure 3-5). The costs of Scenario 2 (EfW within Darlington) are lower than all the other scenarios, because the kerbside collected green waste continues to go to the existing windrow facilities and there is low transfer and transport costs. The most expensive scenario is the Base Case due to the cost of purchasing LATs permits from other authorities.

In terms of the overall assessment of socio-economic objectives Scenario 6 (EfW with increased recycling) scores the highest, predominantly due to performing well in each criterion, owing to low cost, high public involvement and a substantial level of jobs created. The Base Case is the least favourable option, because it combines high costs, low levels of public involvement and few additional jobs.

Table 3-10: Socio-economic objectives – performance of scenarios

Objectives	Criterion	Base Case	Sc 1. High recycling	Sc 2. EfW within Darlington	Sc 3. EFW outside Darlington	Sc 4. MBT-AD within Darlington	Sc 5. Gasification within Darlington	Sc 6. EfW within Darlington and increased recycling
8. To provide local employment opportunities	Number of direct jobs created (jobs estimated)	61	74	75	79	97	84	86
9. To provide opportunities for public involvement /education	Potential for participation in recycling and composting (%)	58811	111741	58811	111741	58811	58811	105860
10. To minimise costs of waste management	Overall costs (£million 2009 – 2034)	438	361	270	282	336	302	286

Table 3-11: Socio-economic objectives – value performance[10]

Objectives	Criterion	Base Case	Sc 1. High recycling	Sc 2. EfW within Darlington	Sc 3. EFW outside Darlington	Sc 4. MBT-AD within Darlington	Sc 5. Gasification within Darlington	Sc 6. EfW within Darlington and increased recycling
8. To provide local employment opportunities	Number of direct jobs created (jobs estimated)	0.00	0.36	0.39	0.50	1.00	0.64	0.69
9. To provide opportunities for public involvement /education	Potential for participation in recycling and composting (%)	0.00	1.00	0.00	1.00	0.00	0.00	0.89
10. To minimise costs of waste management	Overall costs (£million 2009 – 2034)	0.00	0.46	1.00	0.93	0.61	0.81	0.91
TOTAL		**0.00**	**1.82**	**1.39**	**2.43**	**1.61**	**1.45**	**2.49**
Rank		**7**	**3**	**6**	**2**	**4**	**5**	1

10 The scenario, which scores the highest, is best performing. A rank of 1 shows the best performing scenario, a rank of 7 shows the worst performing scenario. The results should not be regarded as a precise overall measure of performance; the two decimal places are retained only for consistency.

3.7 OPERATIONAL OBJECTIVES

The detailed analysis of the operational aspect are presented in Appendix 2. The summarised outputs of the assessment of operational objectives are listed in Table 3-12 and the normalised value scores in Table 3-13.

The deliverability of service solution is based on professional judgement but centres around the potential hurdle of obtaining planning permission for sites and the status of technologies. Due to public perception the EfW scenarios are likely to experience more difficulties in obtaining planning permission. The publics perception is assumed to be better for newer technologies such as gasification and MBT-AD, however, it is likely that opposition will be raised against any proposed waste treatment facility.

The performance of some of the scenarios is dependant on high levels of public involvement such as the high kerbside recycling in Scenario 1, making the deliverability of the scenario vulnerable to the public's participation and uptake. Therefore, scenarios such as EfW with no additional kerbside collections score high due to reduced dependency on the public.

The results show that Scenario 3 (EfW outside Darlington) is the best performing option. This is attributed to no requirement to build a processing facility within the Darlington region, therefore causing less planning permission issues. The scenarios also scores well because it is a proven technology, the scenarios have high landfill diversion levels and they require limited public involvement.

The worst scoring scenario is the Base Case. This is due to the scenario achieving poor recycling, recovery and landfill diversion levels.

Table 3-12: Operational objectives – performance of scenarios

Objectives	Criterion	Base Case	Sc 1. High recycling	Sc 2. EfW within Darlington	Sc 3. EFW outside Darlington	Sc 4. MBT-AD within Darlington	Sc 5. Gasification within Darlington	Sc 6. EfW within Darlington and increased recycling
11. To ensure reliability of delivery	Maturity of technology/markets	1.00	0.90	0.90	0.90	0.50	0.40	0.90
	Public acceptance/ achievement of planning permission	2.00	1.65	0.00	1.83	1.00	0.45	0.00
	Public involvement required (participation rate)	137	350	137	137	306	137	302
12. To conform with waste policy	Percentage of material recovered (%)	22.70	35.60	91.20	91.20	66.00	91.20	91.00
	Percentage of material recycled/composted (%)	23.20	40.30	23.20	23.20	35.30	27.70	28.70
	Percentage of BMW diverted from landfill (%)	22.93	36.38	91.46	91.46	79.10	91.46	91.46

Table 3-13: Operational Objectives – Value Performance[11]

Objectives	Criterion	Base Case	Sc 1. High recycling	Sc 2. EfW within Darlington	Sc 3. EFW outside Darlington	Sc 4. MBT-AD within Darlington	Sc 5. Gasification within Darlington	Sc 6. EfW within Darlington and increased recycling
11. To ensure reliability of delivery	Maturity of technology/markets	1.00	0.83	0.83	0.83	0.17	0.00	0.83
	Public acceptance/ achievement of planning permission	1.00	0.83	0.00	0.91	0.50	0.23	0.00
	Public involvement required (participation rate)	0.61	0.00	0.61	0.61	0.13	0.61	0.14
12. To conform with waste policy	Percentage of material recovered (%)	0.00	0.19	1.00	1.00	0.63	1.00	1.00
	Percentage of material recycled/composted (%)	0.00	1.00	0.00	0.00	0.71	0.26	0.32
	Percentage of BMW diverted from landfill (%)	0.00	0.20	1.00	1.00	0.82	1.00	1.00
TOTAL		**2.61**	**3.04**	**3.44**	**4.35**	**2.95**	**3.10**	**3.29**
Rank		**7**	**5**	**2**	**1**	**6**	**4**	**3**

[11] The scenario, which scores the highest, is best performing. A rank of 1 shows the best performing scenario, a rank of 7 shows the worst performing scenario. The results should not be regarded as a precise overall measure of performance; the two decimal places are retained only for consistency.

3.8 TOTAL VALUE PERFORMANCE OF SCENARIOS

The total value performance scores of the scenarios for each of the main objectives are summarised in Table 3-14 to give an overall measure of performance. This shows that Scenario 5 (Gasification) performs best followed by Scenario £ (EfW outside Darlington) with the Base Case scoring the worst.

Table 3-14: Total value performance

Objectives	Base Case	Sc 1. High recycling	Sc 2. EfW within Darlington	Sc 3. EFW outside Darlington	Sc 4. MBT-AD within Darlington	Sc 5. Gasification within Darlington	Sc 6. EfW within Darlington and increased recycling
Environmental	4.98	8.99	10.81	9.35	4.69	11.67	10.06
Socio-economic	0.00	1.82	1.39	2.43	1.61	1.45	2.49
Operational	2.61	3.04	3.44	4.35	2.95	3.10	3.29
Total	7.59	13.85	15.64	16.14	9.26	16.22	15.84
Rank	**7**	**5**	**4**	**2**	**6**	**1**	**3**

3.8.1 Criteria Weighting

The assessment so far has been undertaken on the basis that the appraisal indicators are of equal importance. As there are 24 indicators, it should be recognised that each contributes about 4% to the outcome of the appraisal. Decision-makers and/or stakeholders are likely to attach more importance to some indicators or criteria than to others. Some indicators may be of critical importance and could 'swing' the outcome of the appraisal whilst others may be of interest, but be of much less consequence. Applying 'weights' to the value performance information can assist in assessing the relative importance of indicators. The weighting factors used for the BPEO assessment for Darlington was derived as an average from the weighting factors set by Officers from Darlington Borough Council (including operational strategy and financial roles). The weighting factors are listed in Table 3-15, and are applied to the following tables.

Table 3-15 BPEO criteria weighting for Darlington

Objectives	Criterion	Average
1. To ensure prudent use of land and other resources	Resource depletion (avoided burden in million years) – *WISARD output*	4.10
	Land take (hectares) *(performance score)*	3.00
2. To reduce greenhouse gas emissions	Emissions of greenhouse gases (000 tonnes equivalent of CO_2) – *WISARD output*	7.40
3. To minimise air quality impacts	Emissions which are injurious to public health (Human Toxicity Index) – *WISARD output*	4.10
	Air acidification (tonnes equivalents of H^+) – *WISARD output*	1.60
	Ozone depletion (tonnes equivalents of CFC-11) – *WISARD output*	1.70
	Extent of odour problems *(performance score)*	1.50
	Extent of dust problems *(performance score)*	1.50
4. To conserve landscapes and townscapes	Visual and landscape impacts *(performance score)*	5.60
5. To protect local amenity	Extent of noise problems *(performance score)*	3.80
	Extent of litter and vermin problems *(performance score)*	4.00
6. To minimise adverse effects on water quality	Eutrophication (tonnes equivalents of PO_4) – *WISARD output*	3.90
	Extent of water pollution *(performance score)*	3.90
7. To minimise local transport impacts	Total Transport Distance (thousand kilometres)	4.60
	Proportion of non-motorway/non-dual carriageway (%)	2.50
8. To provide local employment opportunities	Number of jobs created (jobs estimated)	3.90
9. To provide opportunities for public involvement	Potential for participation in recycling and composting (%)	5.10
10. To minimise costs of waste management	Overall costs (£million 2007 - to 2032) - *WASTEFLOW*	12.10
11. To ensure reliability of delivery	Maturity of technology (performance score)	4.50
	Public acceptance/ achievement of planning permission (performance score)	4.80
	Public Involvement required (participation rate)	2.40
12. To conform with waste policy	Percentage of material recovered (%)	4.80
	Percentage of material recycled/composted (%)	4.20
	Percentage of BMW diverted from landfill (%)	5.00

Applying these weightings to the scores given above provides the following overall scores shown in Table 3-16.

Table 3-16: Overall weighted performance

Objectives	Base Case	Sc 1. High recycling	Sc 2. EfW within Darlington	Sc 3. EFW outside Darlington	Sc 4. MBT-AD within Darlington	Sc 5. Gasification within Darlington	Sc 6. EfW within Darlington and increased recycling
Environmental	20.43	29.12	38.50	33.77	15.94	41.85	35.92
Socio-economic	0.00	12.07	13.62	18.30	11.28	12.33	18.23
Operational	10.76	13.80	15.01	19.39	13.56	13.45	15.22
Total	31.19	54.99	67.13	71.46	40.78	67.62	69.37
Rank	**7**	**5**	**4**	**1**	**6**	**3**	**2**

Table 3-16 shows that Scenario 3 (EfW outside Darlington) now scores the highest after the weightings have been applied, followed by Scenario 6 (EfW with increased recycling). The Base Case scores the lowest. In summary, the scenarios with thermal treatment (Scenarios 2, 3, 5 and 6) are favoured and can form the BPEO for Darlington.

The MBT-AD plant with in-vessel composting of the source segregated biowaste is seen to have higher environmental impacts within WISARD than thermal treatment facilities due to the digestate component being landfilled and lower energy generation. There is also risk of finding a market for MBT derived RDF. Therefore, the scenario adopting the MBT-AD process scores less favourably than the thermal conversion technologies. The scenario additionally fairs lower due to the other non-WISARD factors because of its large landtake and multiple processes on one site causing supplementary environmental issues.

Minimising overall cost are identified as the most influential objectives within the BPEO assessment. Therefore EfW scenarios perform well, because they combine overall lower costs of waste management with a generally high maturity of technology. The costs of having an EfW plant within Darlington or utilising spare capacity in a 3rd party come out quite similar and the determining factors will be securing a 3rd party gate fee at a cost cheap enough to make the additional transport worthwhile.

It should be acknowledged that the second highest scoring scenario, Scenario 6 (EfW within Darlington with increased recycling) requires high public involvement to achieve the higher recycling levels. Experience from Daventry District Council indicates that it may be possible to achieve a high recycling rate with the introduction of green waste collection, but the performance depends on local factors such as education, public awareness of recycling, type of housing but also the waste composition. It should be noted that costs for the educational support programmes to achieve the recycling/composting performance are not known and have not been included in the analysis. Therefore it may increase the overall waste management costs. However, Scenario 6 is preferred due to its higher recycling, which is the factor providing a larger benefit and although it requires more education and higher participation levels it also increases awareness of the public towards waste related issues.

This benefit has to be compared to the risk associated with the required public participation rate.

A BPEO waste management solution is not necessarily one of the scenarios assessed, but the modelled scenarios are merely to illustrate the key policies that will be typified by the BPEO solution. Examination of the key aspects of the results shows that the most important elements of a BPEO waste management system will include the following:

- Diversion of waste from landfill
- Energy recovery through thermal treatment is favourable.
- MBT technology has uncertainty of markets for RDF and compost/digestate that needs to be considered.
- Improvement of the recycling and composting performance is beneficial and can aid the diversion of biodegradable municipal waste (BMW), potentially reducing the extent residual treatment facilities are required.
- Utilisation of a 3rd party treatment facility can be preferential but has significant risks with deliverability of the waste management solution.

Therefore, solutions that maximise these aspects will form the BPEO for Darlington.

3.8.2 Sensitivity of overall scores

The above results show that weighting influences the overall scores. The weightings are measures of how important the various issues (criteria) are to the stakeholders in Darlington and there can be large differences between different groups such as environmental groups, operational staff and the members with responsibility for financial control. Therefore, it is important to assess how robust the findings are by looking at the impacts of variations in the weighting on the overall result.

We have run a model that varies the weightings of each of the criteria by 100% (i.e. between zero and double the values), such that the robustness of the decision can be determined. Figure 3-7 demonstrates the range of scores for each scenario under the varied weighting values. Scenario 3 displays predominantly the highest scores under the varied weighted values although with a significant overlap of Scenarios 2, 5 and 6.

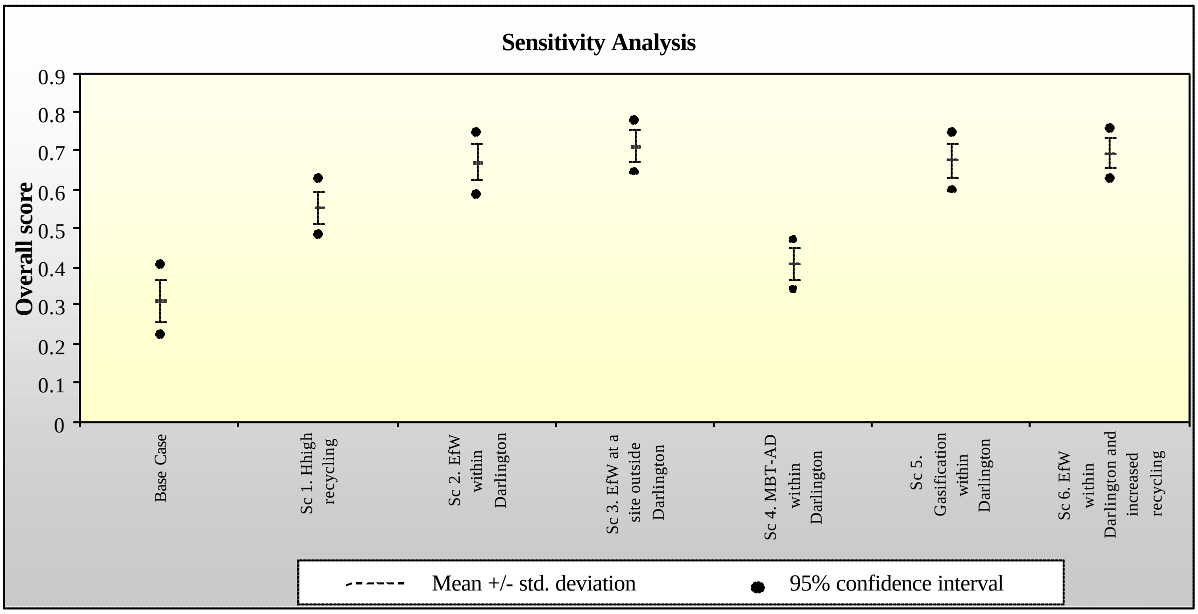


Figure 3-7: Sensitivity of overall scores

Further analysis examines the ranking of the scenarios during the sensitivity analysis as shown in Figure 3-8. The figure indicates that varying the weightings causes all the thermal technologies (Scenarios 2, 3, 5 and 6) to be potentially the preferred scenario, indicating the closeness of the results. The results additionally show that given certain weightings Scenario 1 (High Recycling) can perform well, almost overlapping the thermal combustion scenarios.

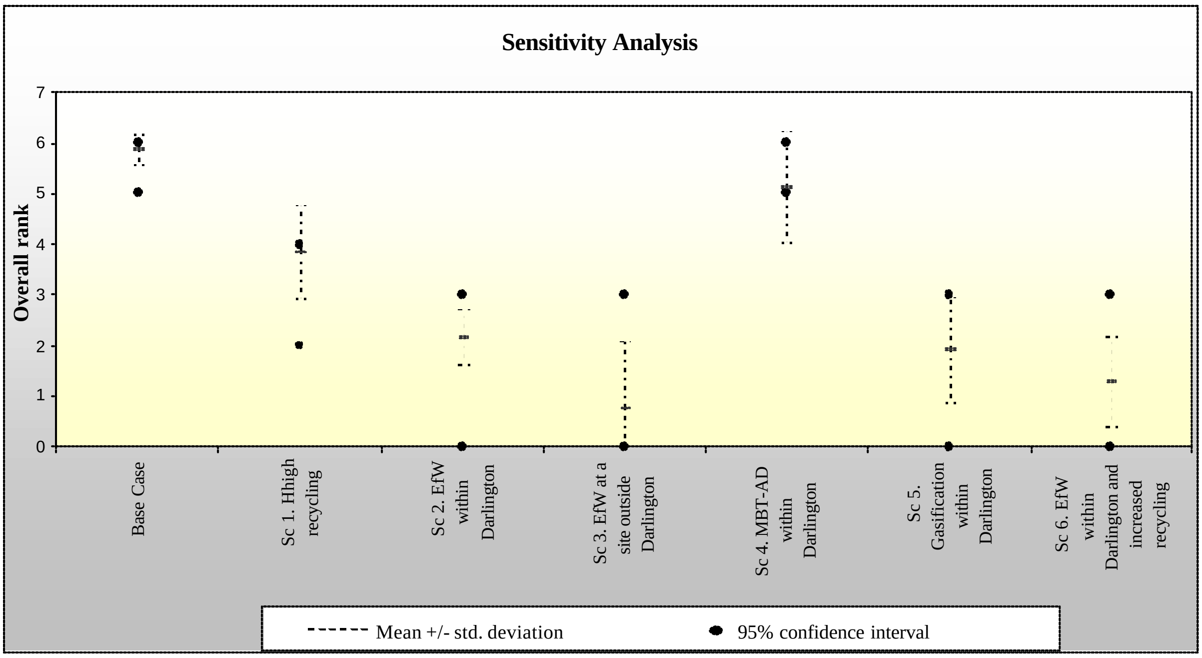


Figure 3-8: Variation in ranking during sensitivity analysis

CONCLUSIONS

To assess the BPEO for Darlington seven scenarios of various combinations of residual waste treatment and recycling activities have been evaluated against an agreed set of criteria. The principal variables for the scenarios were the choice of residual treatment facilities and the introduction of additional recycling collections. The infrastructure to deliver these scenarios were evaluated and assessed against a range of criteria based on environmental, socio-economic and operational issues in line with government guidance. Weighting factors were applied to the assessments to reflect the relative importance of each criterion, which subsequently enabled overall scores for each scenario to be determined.

The analysis shows that Scenario 3 (EfW outside Darlington) is ranked the highest. The scenario is the best performing option in both the operational objectives and socio-economical objectives and fourth highest in the environmental. The higher operational score is primarily due to the assumption that the plant already exists and therefore there are limited planning risks. The costs for all the thermal combustion scenarios are the least expensive options and have little variation.

The delivered BPEO waste management solution is not necessarily one of the scenarios assessed here, as the modelled scenarios are merely to illustrate the key policies that will be typified by the BPEO solution. Examination of the results shows some key aspects of the waste management solution that will go to form the Best Practicable Environmental Option (BPEO) for managing waste in Darlington, they include:

- Diversion of waste from landfill
- Energy recovery through thermal treatment is favourable.
- MBT technology has uncertainty of markets for RDF and compost/digestate that needs to be considered.
- Improvement of the recycling and composting performance is beneficial and can aid the diversion of biodegradable municipal waste (BMW), potentially reducing the extent residual treatment facilities are required.
- Utilisation of a 3rd party treatment facility can be preferential but has significant risks with deliverability of the waste management solution.

These aspects are expressed predominantly in Scenario 3 (EfW outside Darlington). However, it may not be possible to purchase sufficient capacity at an external EfW plant at a competitive price and therefore other options also need to be considered.

These key aspects generated by this report will be further considered in the procurement process for recycling and residual treatment technologies in order to provide the BPEO for Darlington. There are many other influences outside of this evaluation such as the ability of the market to deliver, additional funding options and the overall deliverability of any solution. Other funding streams (PFI, local performance agreements etc) are likely to be only supported if higher recycling is achieved and these funds may be sufficient to counteract the differences in this BPEO assessment.

Appendices

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