AEA Energy & Environment
From the AEA group

Strategic Environmental Assessment of Lincolnshire Waste Partnership's Waste Strategy – Environmental Report

Final version

Report to Lincolnshire County Council

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AEA Energy & Environment
The Gemini Building
Fermi Avenue
Harwell International Business Centre
Didcot
OX11 0QR

t: 0870 190 2831
f: 0870 190 6318

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AEA Technology plc

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Author	Name	Carlos Martinez, Stephanie Boulos, Nicole Jainter
Approved by	Name	Andy Davis
	Signature	
	Date	16th May 2008

Executive summary

AEA Energy & Environment has been commissioned to revise and update the Lincolnshire Waste Partnership's Joint Municipal Waste Strategy (JMWS), including undertaking a Strategic Environmental Assessment (SEA) of the Waste Strategy in accordance with the Environmental Assessment of Plans and Programmes Regulations 2004.

The SEA is being conducted using the SEA guidance provided by the Government. However, we recognise that the SEA process, as it relates to Waste Strategies, is still in its infancy and as a result an innovative methodology needs to be developed.

Why do we need a SEA?

This Environmental Report has been produced as part of the SEA process and presents the assessment of the impact of Lincolnshire Waste Partnership's Joint Municipal Waste Strategy on the environment, economy and health of Lincolnshire. The Waste Strategy will determine the direction the Partnership will take for dealing with the county's waste up to and beyond 2020.

Structure of the SEA

The first stage of the SEA process was to prepare a Scoping Report. This considered the impact of other relevant strategies, plans and programmes, providing background information and outlining the criteria and waste management scenarios to be used for conducting the assessment. It was developed through consultation with statutory bodies, and key local stakeholders. This consultation defined the assessment criteria and proposed targets for waste minimisation, re-use, recycling/composting and recovery of waste.

This Environmental Report represents the second stage of the SEA process. A range of waste management scenarios was modelled and the relative impact of each scenario evaluated against each of the 28 criteria identified. Additionally, the Environmental Report assesses the significance and compatibility of all criteria, and the sensitivity of certain key factors on the overall outcomes.

The third stage of the SEA process involved a twelve-week public consultation exercise on the draft Environmental Report that sought the public's views on services, waste treatment technologies and the importance assigned to each of the assessment criteria. Once the public consultation completed the outcomes of the exercise were feed into the SEA, and the Environmental Report has been finalised.

General conclusions

It should be emphasised that the purpose of the SEA is not to promote the best solution for delivering the waste strategy; instead the assessment methodology applied through the SEA enables the benefits and impacts to be identified for each scenario. In identifying its preferred waste management system, the Partnership will need to consider these different aspects and will have to agree inevitable 'trade-offs' to select the most suitable scenario for Lincolnshire.

Conclusions specific to modelling of the integrated waste management scenarios.

The following table presents the different scenarios that were modelled:

Table 1.1: Residual waste treatment scenarios

Scenario		
Scenario 1	Baseline	100% of residual waste to landfill
Scenario 2	Mechanical Biological Treatment with aerobic stabilisation phase	MBT with an aerobic stabilisation phase, the output is landfilled
Scenario 3	Mechanical Biological Treatment with Refuse Derived Fuel combusted on site	MBT with the output used as a refuse derived fuel (RDF) on site in a small scale energy to waste plant
Scenario 4	Mechanical Biological Treatment with Refuse Derived Fuel to a 3rd party	MBT with the RDF being sold to 3rd party such as cement kiln
Scenario 5	Mechanical Biological Treatment with anaerobic digestion and aerobic stabilisation phase	MBT with anaerobic digestion and aerobic stabilisation phases. The outputs are a compost product (which might be used in landfill engineering) and a biogas
Scenario 6	Mechanical Biological Treatment with anaerobic digestion and Refuse Derived Fuel combusted on site	MBT with anaerobic digestion and aerobic stabilisation phases. There are two outputs, a stabilised output which is landfilled and a RDF which is used on site
Scenario 7	Energy from Waste + Electricity	Energy from waste with electricity generation
Scenario 8	Energy from Waste + Combined Heat and Power	Energy from waste with electricity and heat generation
Scenario 9	Gasification	Advanced thermal treatment (ATT)

The modelling was conducted applying the following assumptions:

- The reduced waste growth rates for municipal waste (shown in Section 2.2) are achieved.
- The recycling targets set in the waste strategy for household waste are achieved
- The landfill diversion targets are met.
- The residual waste treatment facility accepts over 60% of the household residual waste, 30% of residual waste from Household Waste Recycling Centres and all co-collected commercial residual waste.
- The annual capacity for the residual waste treatment facility is set at a maximum of 150,000 tonnes, enough to exceed the landfill diversion targets, but not to treat all residual waste arisings.
- Current landfill contractual obligations are fulfilled.

Table 1.2 below presents the ranking of each scenario before and after the criteria assessment scores have been weighted.

Scenarios 7 (EfW) and 8 (EfW with CHP) perform well. They score highly in environmental terms, and also highly against the waste hierarchy and policy criteria. This is because the technology provides energy recovery and produces minimal amounts of reject material requiring landfill disposal. The combination of these factors allows both scenarios to score well against the environmental criteria, particularly on a number of the WRATE[1] assessed criteria. These options also perform well in economic terms, being the second and third least expensive options after scenario 9 (ATT) scenario. On the other hand, the thermal treatment scenarios score lower in terms of:

- Water usage, due to the high use of water for flue gas cleaning and in the steam raising plant, and
- Amount of hazardous waste produced as fly ash, which requires specialist treatment or disposal.

The other thermal treatment scenario 9 (ATT) scores the second highest and is the least expensive option. However, the ATT process has a very limited track record in processing municipal waste and consequently the costs are difficult to accurately predict. Additionally, as there are currently no large-scale commercial plants in operation in the UK, this will impact substantially on the bankability of the technology. It should also be noted that the costs provided within this SEA are indicative and for comparison purposes only. It is only through a procurement exercise that actual costs can be determined. In conclusion, although the ATT scenario performs well, it may not be acceptable to the Partnership due to uncertainty over its long-term performance and deliverability issues.

The conclusion on the biological treatment (MBT) based scenarios is that scenarios 4 and 5 score better than the rest. Scenario 5, MBT with anaerobic digestion and aerobic stabilisation, as the highest score of all MBT based scenarios because of the higher recycling rate it achieved and its overall lower cost. Scenario 5 is rank second overall after scenario 8.

Scenario 4, MBT with RDF to 3rd party, scores well in terms of the waste hierarchy and policy requirements. Nevertheless, it has the highest transport impact due to the ongoing need to transport reject material to landfill and the transport of RDF to a different facility.

All the MBT scenarios score poorly in terms of transport impact due to the large quantities of material that, once processed, need further onward transportation either to landfill or other treatment sites. The MBT processing operation also has the highest potential to generate noise, odour and dust. The higher quantities of Compost Like Output (CLO) that are produced could impact on water quality when leachate from the compost product is generated in the landfill site. However, the scenarios score well in the prudent use of water.

The Base Case scenario (100% landfill) scores well in terms of minimising the potential for nuisance from noise, odour and dust, because no processing plant is required; processing waste will generate noise, odour and dust. Furthermore, as this scenario does not require treatment of the residual waste, criteria such as land take and water use also score well. However, the scenario performs very poorly in all the waste hierarchy and policy requirements due to the reliance on landfill as a disposal route. The Base Case scores poorly in terms of minimising greenhouse gas emissions due to both landfilling of biodegradable waste (which will generate methane) and a lower level of energy recovery than most of the other scenarios. This means that there is a higher level of resource depletion, as the energy produced by other treatment methods can be off-set against the use of fossil fuels. The scenario also scores poorly in economic terms, due to the smaller workforce required.

1 WRATE: Waste and Resource Assessment Tool for the Environment software which replaced WISARD software in 2007

Scenario 3, MBT – RDF on site scores lowest of all, mainly due to poor environmental performance and is considerably more expensive than all the other scenarios because an on-site RDF combustion facility is required. On the other hand, it scores well in certain objectives because of both the amount of energy recovered and the number of jobs created through the extra facility required to burn the RDF onsite.

Table 1.2: Ranked scenarios

Scenario	Total assessment score	Ranking (without weightings)	Score with weighting	Ranking weighted
Sc 1- Base Case	10.45	**6**	40.43	**7**
Sc 2- MBT-Aerobic	8.32	**8**	35.72	**8**
Sc 3- MBT-RDF on-site	7.60	**9**	32.73	**9**
Sc 4- MBT-RDF to 3rd party	10.99	**5**	42.14	**5**
Sc 5- MBT-AD+Aerobic	11.08	**4**	47.80	**2**
Sc 6- AD+Aerobic (RDF onsite)	9.11	**7**	41.53	**6**
Sc 7- EfW + electricity	11.88	**3**	47.73	**3**
SC8 – EfW + CHP	14.18	**1**	55.95	**1**
Sc 9- Gasification	12.00	**2**	47.54	**4**

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GLOSSARY OF TERMS

AD	Anaerobic Digestion
ATT	Advanced Thermal Treatment (gasification/pyrolysis)
BMW	Biodegradable Municipal Waste
BPEO	Best Practicable Environmental Option
CHP	Combined Heat & Power
EfW	Energy from Waste
IVC	In-vessel composting
JMWMS	Joint Municipal Waste Management Strategy
LATS	Landfill Allowance Trading Scheme
LASU	(Defra) Local Authority Support Unit
LDD	Local Development Document
LDF	Local Development Framework
LWP	Lincolnshire Waste Partnership
MBT	Mechanical Biological Treatment
MSW	Municipal Solid Waste
MWMS	Municipal Waste Management Strategy
ODS	Ozone Depleting Substances
PPS10	Planning Policy Statement 10
RDF	Refuse Derived Fuel
ROCs	Renewables Obligation Certificates
RSS	Regional Spatial Strategy
SEA	Strategic Environmental Assessment
WCA	Waste Collection Authority
WDA	Waste Disposal Authority
WPA	Waste Planning Authority

1 Introduction

1.1 Background to Lincolnshire's Joint Municipal Waste Strategy

The Lincolnshire Waste Partnership (LWP) consists of eight partnering local authorities: Boston Borough Council, City of Lincoln Council, East Lindsey District Council, Lincolnshire County Council, North Kesteven District Council, South Holland District Council, South Kesteven District Council and West Lindsey District Council, and the Environment Agency.

The Partnership has been proactive over the last seven years in developing a joint municipal waste management strategy and commissioning additional research on the issues around waste management and technology options available to treat residual waste. Since its first Joint Municipal Waste Management Strategy (JMWMS) was developed in 2002, the objectives of the Partnership have moved on, driven by new legislation and mandatory requirements surrounding how waste should be managed. In addition, the Environmental Assessment of Plans and Programmes Regulations 2004 introduced a requirement for a Strategic Environmental Assessment (SEA) to be produced for a number of statutory documents including Municipal Waste Management Strategies (MWMS). As the Partnership is revising its JMWMS there is a statutory requirement to undertake an SEA on this document.

However, given that a substantial degree of work and consultation has been carried out through the development of past waste strategies, the process of updating and refreshing the existing strategy and the use of the SEA procedure will assist the Partnership in providing a validation process to past decisions.

The following provides a brief summary of how the JMWMS has evolved since 2002 and explains where we are now.

Municipal Waste Strategy for Lincolnshire 2002

This was the first major waste management strategy developed by the Partnership and sets targets for recycling and composting. The strategy aimed to develop a strategic framework of waste management options and solutions which could be implemented in such a manner that would ensure Lincolnshire County Council and all seven District Councils achieve the targets set by the UK Government and comply with National and European legislation. The strategy incorporated an options assessment, which was completed as follows:

> Sustainability objectives and indicators were developed that broadly (applying DETR methodology at the time) considered three indicator categories: cost, planning and environmental related criteria. An evaluation of each option was undertaken by applying a common scoring system on a scale of 0 to 1. Weightings were applied to each criterion in consultation with District, County and Environment Agency Officers. At the end of that process, an option based around the development of treatment and disposal infrastructure within two zones in the County (in the North and in the South) scored highest. The infrastructures included within the preferred option were up to three small scale Energy from Waste (EfW) facilities, eight windrow composting and a further five In-Vessel Composting (IVC) plants, seven landfills for final disposal and up to five Material Recycling Facilities (MRFs), seven transfer stations and thirteen Household Waste Recycling Centres (HWRCs).

The recommendations on implementing the preferred option strongly emphasised the need for all the districts and the County to increase recycling and composting rates using kerbside collection, bring banks and HWRCs. The strategy also emphasised the time requirements for delivery of the consultation, planning and commissioning stages for a thermal treatment solution.

Draft Addendum Strategy Report 2005

A subsequent draft addendum report was produced in 2005. The review process identified new technologies and incorporated more current data including waste arisings and composition. The addendum provided an update to the following:

- The statistical data the strategy was based on;
- Legislative context, with the main impact being the increased biodegradable content of municipal solid waste from 60% to 68%;and an
- Update on new technologies and impact on the preferred option. Mechanical Biological Treatment (MBT) was the main new technology considered. MBT is a residual waste treatment option, but the output still needs to be disposed of either through thermal treatment or landfill.

The addendum indicated that the preferred option identified in the 2002 strategy was still valid, but could also be delivered with a variety of residual waste treatment technologies (e.g. Anaerobic Digestion (AD), MBT and EfW). The preferred option did therefore still include a combination of higher recycling and composting, with EfW to achieve the diversion of biodegradable waste from landfill targets as set by Defra.

This addendum document has always remained as a draft addendum.

Joint Municipal Waste Strategy, Draft Core Discussion Document March 2007

Following the successful award of a Defra Local Authority Support Unit (LASU) grant, the Lincolnshire Waste Partnership funded an exercise to update and restructure the waste strategy documents, incorporating the renewed aims and objectives of the Lincolnshire Waste Partnership, whilst retaining the thrust and direction of the original strategy. A draft core discussion document was produced in line with new Government Guidance on Municipal Waste Management Strategies produced by Defra in July 2005. This discussion document concluded that a complete refresh of the strategy (including baseline and options appraisal modelling) was required concurrently with a Strategic Environmental Assessment (SEA).

It was clear that the Lincolnshire Waste Partnership needed to take action to implement the existing waste strategy if they were to meet recycling targets, avoid the impacts of rising landfill tax and the significant fines from continuing to landfill their waste. Therefore, whilst the district authorities commenced with the implementation of higher performing collection schemes, the County Council began the process of developing a business case to identify the preferred approach to delivering the required residual waste treatment.

Outline Business Case for residual waste treatment facility

In the summer of 2006 independent advisors were commissioned by Lincolnshire County Council to develop an Outline Business Case (OBC) to support the procurement of residual waste treatment facilities. The OBC will assess the available technical, financial and procurement options in order to develop an acceptable solution to divert residual waste from landfill and thus enable the county to meet its landfill allowance targets (LATS) by 2020 and avoid substantial fines. The OBC cannot be finalised until the current consultation process is complete.

1.2 Where are we now?

Whilst the Lincolnshire County Council procurement project progresses, the Partnership is in the process of developing a new JMWMS to comply with the revised government guidance on waste strategies and the SEA Directive.

The new JMWMS will determine the direction that the Partnership will take for dealing with its municipal waste and how it will meet the revised recycling/composting target of 55% by 2015 and the regional and national targets as set in the regional waste strategy[2] and the new Waste Strategy for England 2007[3].

The Strategy details the challenges facing the Partnership, which primarily includes the diversion of waste away from landfill in order to meet statutory targets, and thereby to avoid significant financial penalties under the Landfill Allowance Trading Scheme (LATS). Consequently, the Partnership needs to develop a long-term solution to manage its waste streams: one in which waste is viewed as a resource and managed in a more sustainable manner. The challenges that need to be addressed by the strategy are:

- To increase recycling and composting
- To reduce the amount of biodegradable waste going to landfill
- To reduce the amount of residual waste requiring final disposal
- To minimise the amount of waste arising in the county
- To address the rising cost of waste management

The Partnership has developed a vision of what the new Strategy should aim to achieve. This vision is summarised in the following 10 key objectives:

Objective 1. To prevent the growth in municipal waste by promoting waste reduction and reuse initiatives to ensure no more than 225kg of residual household waste per person is produced by 2020.

Objective 2. To promote waste awareness through co-ordinated public education and awareness campaigns, and effective community engagement.

Objective 3. Across Lincolnshire to achieve 55% recycling and composting by 2015.

Objective 4. Across Lincolnshire to achieve a uniform dry recyclables waste stream by 2013.

Objective 5. To progressively increase the recovery and diversion of biodegradable waste from landfill to meet and exceed the Landfill Directive diversion targets.

Objective 6. To ensure that residual waste treatment supports energy recovery and other practices higher up the waste hierarchy.

Objective 7. To deliver best value for money waste management services addressed on a countywide basis.

Objective 8. To engage with local businesses to encourage the reduction and recycling of commercial waste.

Objective 9. To actively engage, lobby and work with local, national, governmental and other organisations on sustainable waste management issues.

Objective 10. As Local Authorities, to set an example by preventing, reusing, recycling and composting our own waste and using our buying power to positively encourage sustainable resource use.

2 East Midlands Regional Waste Strategy, January 2006

3 Waste Strategy for England 2007, Defra

The Partnership recognises that delivering these objectives will require the implementation of specific activities, which are summarised below:

- Increase awareness amongst residents, local communities, and businesses about managing the waste they produce, and involving them in the planning and delivery of waste management services.
- Recycling and composting as much as practicable and working towards greater commonality of services to improve waste management services.
- Plan for and provide a new residual waste treatment facility to divert waste from landfill.

1.3 Strategic environmental assessment – an overview

The Environmental Assessment of Plans and Programmes Regulations 2004 introduced a requirement for a Strategic Environmental Assessment (SEA) to be produced for a number of statutory documents including Municipal Waste Management Strategies. As the Partnership is revising its Waste Strategy, there is a statutory requirement to undertake an SEA on this document.

In order to be most effective, the Office of the Deputy Prime Minister[4] recommends that the SEA process, including the preparation of the Environmental Report, should be conducted at the same time as the waste strategy is prepared. The Partnership believes that revising its waste strategy in parallel with the preparation of the SEA will provide significant benefits, as implementation of the strategy, through long-term procurement of waste management infrastructure, would then be supported by the SEA.

AEA Energy & Environment has been commissioned by Lincolnshire County Council to undertake the SEA and help revise its waste strategy.

In the first stage of the SEA process a Scoping Report[5] was produced. The Scoping Report:

- Described the SEA procedure;
- Considered the impact of other relevant strategies, plans and programmes;
- Provided background information;
- Consulted statutory and key local/regional consultees;
- Outlined the criteria that will be used for conducting the SEA assessment; and
- Outlined the waste management scenarios considered for assessment.

The draft Environmental Report represents the second stage of the SEA process. The purpose of the Environmental Report is:

- To summarise the baseline information;
- To describe the assessment methodology and the key assumptions made;
- To model a range of different waste management scenarios;
- To evaluate the relative impacts of each waste management scenario for each of the 28 criteria which were identified for conducting the assessment;
- To assess the significance and sensitivity of any of these effects; and
- To assess the internal compatibility of the SEA objectives.

4 A Practical Guide to the Strategic Environmental Directive, ODPM 2005

5 Strategic Environmental Assessment of LWP's Waste Strategy – Scoping Report. Report by AEA to Lincolnshire County Council, November 2007

The Environmental Report also identifies data gaps and limitations, and discusses how professional judgement was used to assess the risk of any inadequacies.

The third stage of the SEA process involves:

- A 3-month public consultation exercise on the draft Environmental Report to seek the public's views on services, waste treatment technologies, and the weighting of the criteria categories;
- The assigning of weightings to each of the assessment criteria categories, and
- Finalising the Environmental Report.

The outcomes from the consultation exercises, including the final weighting of the criteria, have now been incorporated into the final technical evaluation and presented in this final version of the environmental report.

2 Baseline information

This section presents background information that needs to be considered in assessing the Partnership's Waste Strategy. The key sustainability issues for the Partnership were identified in the Scoping Report that enabled the criteria and targets for assessing the Waste Strategy to be developed.

Within the East Midlands Region, Lincolnshire is the largest County covering 592,075 hectares, and the fourth largest in England covering 5% of England. Lincolnshire was one of the fastest growing populations in England between 1991 and 2001 at 10% compared to 3% nationwide. Since 2001 and up to 2005, Lincolnshire's population grew by a further 5%, with wide changes between the districts. North Kesteven grew by a further 8.2% compared to 2.9% in South Kesteven, and in general the rural areas are growing faster than Lincoln City. Looking at the population, Lincolnshire has an ageing population with more than 19% of its population being over 65 years of age, with the highest proportion residing in East Lindsey at 23%.

Lincolnshire was home to 678,700 people in 2005[6], living predominantly in rural areas (70%). The average household is made up of 2.26 persons compared to 2.36 for England as a whole.

2.1 Waste management

This section summarises the information on current municipal waste arisings, waste composition, recycling and disposal of waste. Further details can be found in the Scoping Report.

Within Lincolnshire, it is the district councils (WCAs) that have the responsibility to collect the waste, and the County Council (WDA) that has the responsibility to dispose of it. This results in a variety of different collection services and service providers (either in-house or contractor). In addition, the County Council operates 12 HWRCs across the county to enable residents to recycle, compost and dispose of waste materials.

2.1.1 Waste arisings

The total amount of municipal waste arising in 2006/07 in Lincolnshire amounted to 365,537 tonnes, of which 349,663 tonnes was household waste. Table 2.1 below shows the breakdown of the household waste arising.

Table 2.1: Breakdown of household waste tonnage data (2006/07)

Waste stream	Tonnage
Recycled	79,970
Composted	62,608
Landfilled	207,085
Total	**349,663**

[6] The Changing Demographics of Lincolnshire - An update on population trends in the county, November 2006. http://www.research-lincs.org.uk/

2.1.2 Waste composition

It is important to understand the composition of the waste collected from within the county, as it will determine the available proportions of materials that can be extracted and recovered from the waste. It is also key to assessing the types of facilities required and collection systems needed to extract each component of the waste. In Lincolnshire, Lincoln City (2000), East Lindsey (2004) and South Kesteven (2004) have conducted research into the composition of mixed residual waste collected from householders. Lincoln City's research was conducted in October 2000, sampling nearly 25,000 tonnes and analysing it for composition.

Table 2.2 presents a comparison of the outcomes of the waste composition studies completed, however this should be used carefully as each study used a different methodology.

Table 2.2. Waste composition comparison

	East Lindsey (2004)	**Lincoln City (2000)**	**South Kesteven (2004)**
Category	**% of the total weight**	**% of the total weight**	**% of the total weight**
Recyclable paper	26.7%	12.7%	13.8%
Recyclable card	4.9%	5.4%	
Non-recyclable paper/card	3.1%	1.2%	4.2%
Garden waste	2.6%	5.4%	45.5%
Kitchen waste	26%	31.5%	
Animal waste	1.9%	5.2%	0.0%
Plastic film	5.6%	6.0%	6.8%
Dense plastic	5.1%	6.4%	5.4%
Textiles	1.3%	3.0%	3.0%
Miscellaneous combustible	1.6%	7.3%	7.4%
Miscellaneous non-combustible	4.0%	0.1%	2.9%
Glass	7.0%	7.7%	5.7%
Non-recyclable glass	0.5%	0.9%	
Ferrous metals	2.3%	3.5%	2.7%
Non-ferrous metals	0.8%	0.9%	0.7%
Other metals	0.3%	0.4%	0.0%
Fines	1.9%	0.5%	0.9%
Wood	1.5%	0.5%	0.0%
WEEE	0.6%	0.7%	0.9%
Hazardous	0.6%	0.2%	0.0%
Clinical	0.2%	0.1%	0.0%
Other		0.5%	
Total	**100%**	**100%**	**100%**

2.1.3 Current recycling and composting

The Partnership brings together seven waste collection authorities that have responsibility for collecting waste arising from household and commercial premises. Table 2.3 presents the different schemes that are currently running in each district for household waste. Out of the seven districts, five have moved to alternate weekly collection for residual waste and recycling. Two districts (Boston and South Holland) are not currently operating a green waste kerbside collection. Boston trialled a Saturday green waste collection in Autumn 2007 and is planning to run the collection again next year.

As shown in Table 2.3 there are some differences between the green waste collection schemes operated by the districts. Of the five districts running such a scheme, two offer it on an opt-in basis (South Kesteven and West Lindsey).

Table 2.3: Current waste management services

Local Authority	Residual Waste	Dry Recyclables	Green Waste
Boston	Alternate weekly collection majority in 240 litre bins	Alternate weekly in 240 litre bins Mixed paper, card, plastic bottles, tins and cans	Not currently collected
East Lindsey	Alternate weekly collection majority in 180 litre bins	Alternate weekly in 240 litre bins Mixed paper, card, plastic bottles, tins and cans	Alternate weekly in 240 litre bin
City of Lincoln	Alternate weekly collection in 240 litre bins or weekly collection in 140 litre bins (inner city areas)	Alternate weekly in 240 or 140 litre bins Mixed paper, card, plastic bottles, tins and cans	Alternate weekly in 240 litre wheeled bin
North Kesteven	Alternate weekly collection majority in 240 litre bins	Alternate weekly in 240 litre bins Mixed paper, card, plastic bottles, glass containers, textiles, tins and cans	Alternate weekly in 240 litre bin
South Holland	Weekly black sack collection	Weekly sack collection Mixed paper, card, plastic bottles, plastic film, textiles, tins, cans and glass	Not currently collected
South Kesteven	Alternate weekly collection majority in 240 litre bins	Alternate weekly in 240 litre bins Mixed paper, card, plastic bottles, textiles, tins, cans and glass	Opt in system with a bin charge. Alternate weekly 240 litre bins
West Lindsey	Weekly collection majority in 180 litre bins	Alternate weekly in 240 litre bins Plastic bottles, glass, card, tins and cans Separate paper collection.	Opt in system with a bin charge. Alternate weekly 240 litre bin

Looking at the materials collected through the kerbside schemes, all seven districts collect paper, card, plastics and cans. North Kesteven, South Kesteven, West Lindsey and South Holland also collect glass, and Lincoln City and East Lindsey are looking to include this in their mix. Table 2.4 summarises the materials collected by each district.

Table 2.4. Materials recycled in each partnering authority

	Dry recyclables collected at the kerbside					
Local Authority	Paper	Card	Glass	Plastic	Metal	Textiles
Boston	✓	✓		✓	✓	
East Lindsey	✓	✓		✓	✓	
Lincoln City	✓	✓		✓	✓	
North Kesteven	✓	✓	✓	✓	✓	✓
South Holland	✓	✓	✓	✓	✓	✓
South Kesteven	✓	✓	✓	✓	✓	✓
West Lindsey	✓	✓	✓	✓	✓	

Since 2002, when the original municipal waste management strategy was produced, recycling and composting performance has changed significantly, primarily through the expansion and introduction of new collection services (such as kerbside collection of dry recyclables and garden waste) and the improvement of recycling rates at household waste recycling centres.

Table 2.5 below provides details of the household waste recycling rates achieved between 2001 and 2007 for each district and for the County overall. As it can be seen in Table 2.5 there is wide variation between the recycling rates achieved across the seven authorities. However, overall Lincolnshire County achieved a 40% recycling rate in 2006/7.

Table 2.5: Municipal recycling and composting rates between 2001 and 2007

	2001	2002	2003	2004	2005	2006	2007
Boston	7%	7%	7%	20%	28%	22%	26%
East Lindsey	8%	7%	9%	17%	20%	21%	36%
Lincoln	10%	10%	11%	16%	24%	29%	36%
North Kesteven	5%	5%	16%	10%	39%	49%	56%
South Holland	9%	9%	15%	15%	16%	21%	23%
South Kesteven	7%	7%	7%	14%	15%	26%	30%
West Lindsey	7%	7%	9%	15%	24%	32%	33%
Lincolnshire	**8%**	**7%**	**10%**	**20%**	**27%**	**33%**	**40%**

Figure 2-1 below, presents a breakdown of how waste was managed in each authority during 2006/7. The main variation is the amount of waste collected for composting. The information for Lincolnshire County relates to the amount of waste delivered to the 12 Household Waste Recycling Centres (HWRC) operated by the County Council.

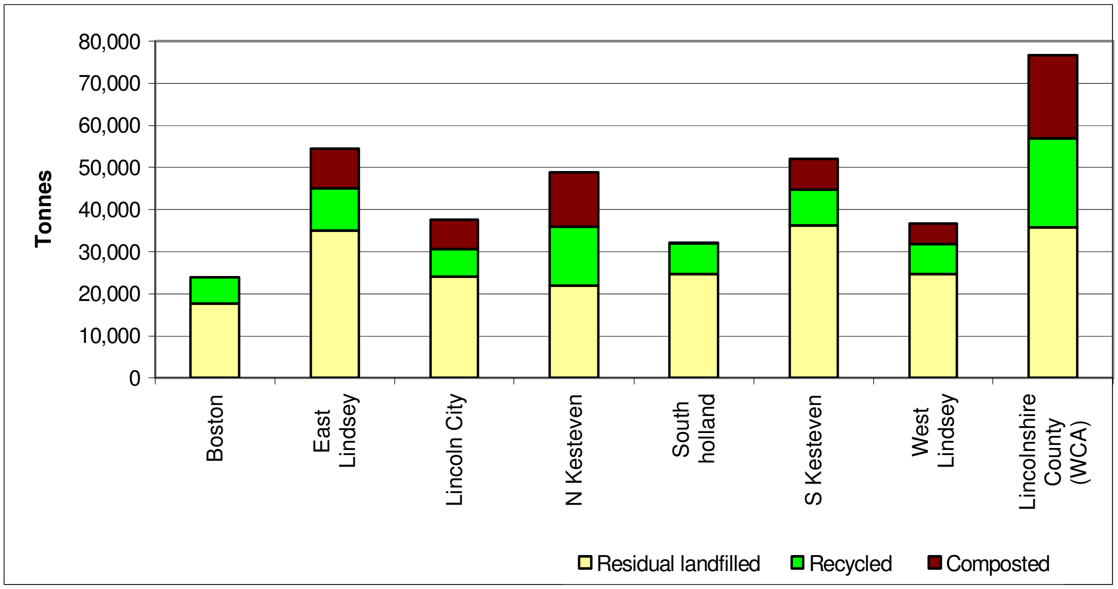


Figure 2-1: Waste management in each authority

2.1.4 Existing contracts

This section briefly presents the current contracts in place to manage waste across the Partnership.

Composting:

Five of the districts currently offer a green waste kerbside collection. In addition, Lincolnshire County Council provides 12 Household Waste Recycling Centres (HWRC) across the County to enable residents to recycle, compost and dispose of waste materials. The County operates 12 composting facility contracts and composted 61,982 tonnes of municipal green waste in 2006/7.

Residual waste

Residual waste treatment facilities in the County are limited to landfill. Lincolnshire County Council disposed of 224,555 tonnes of municipal waste to landfill in 2006/07.

Dry recycling

Five of the Waste Collection Authorities have contractual arrangements with differing private sector operators to process their dry recyclables. There are currently 5 MRFs used to process recyclable materials, two of which are located out of the county. In addition to these facilities, the County Council has let a contract to construct and operate a centralised MRF that will be available for the waste collection authorities to use in the near future (estimated date 2009). Between them, the waste collection authorities also have 197 bring sites enabling the public to recycle cans, paper, glass, textiles and books. Each district is responsible for waste collection arrangements and these are presented in Table 2-6 and Table 2-7.

Table 2.6 Current dry recycling contracts

	Current Material Description	Current Destination
East Lindsey	Mixed paper, card, plastic bottles, tins and cans collected fortnightly in wheeled bins	Greenstar Ltd, Addlethorpe, Skegness (County contract)
West Lindsey	Card, plastic bottles, glass containers, tins and cans collected fortnightly in wheeled bins Separate paper collection	Fox (Owmby) Ltd, Caenby Corner (District contract)
City of Lincoln	Mixed paper, card, plastic bottles, tins and cans collected fortnightly in wheeled bins	HW Martin Ltd (Handler) transporting to Grosvenor Ltd, Peterborough MRF, Peterborough or Transcycle Ltd, Derby (County contract)
North Kesteven	Mixed paper, card, plastic bottles, plastic containers, glass containers, textiles, coat hangers, tins and cans collected fortnightly in wheeled bins	Mid UK Recycling Ltd, Caythorpe (District contract)
South Kesteven	Mixed paper, card, plastic bottles, plastic containers, glass containers, textiles, tins and cans collected fortnightly in wheeled bins	Mid UK Recycling Ltd, Caythorpe (District contract)
Boston	Mixed paper, card, plastic bottles, tins and cans collected fortnightly in wheeled bins	HW Martin Ltd (Handler) transporting to Grosvenor Ltd, Peterborough MRF, Peterborough or Transcycle Ltd, Derby, (District contract)
South Holland	Mixed paper, card, plastic bottles, plastic containers, plastic film, textiles, coat hangers, glass, tins and cans collected weekly in boxes	Mid UK Recycling Ltd, Caythorpe (District contract)

Table 2.7 Current collection contract arrangements

Boston	In house collection
East Lindsey	In house collection
Lincoln	New contract with Cory Environmental in 2006
North Kesteven	In house collection
South Holland	In house collection
South Kesteven	In house collection
West Lindsey	In house collection

2.1.5 Cost

The costs of waste management in 2006/07 outlined in Table 2.8 and Table 2.9 are the costs reported by the individual authorities to Defra through Waste Data Flow. There are some noticeable variations between the districts: Boston has the lowest cost per household at £33.54, compared with £64.28 for East Lindsey.

Table 2.8 Cost of waste collection for 2006/07

Collection of household waste	Number of HH	Overall cost for collection	£/ HH
Boston[7]	27,130	£905,580	**33.54**
East Lindsey	63,423	£3,769,367	**64.28**
Lincoln	40,836	£2,103,621	**52.63**
North Kesteven	45,187	£2,211,074	**49.73**
South Holland	36,867	£1,808,976	**44.39**
South Kesteven	56,651	£2,646,292	**48.65**
West Lindsey	38,837	£2,273,242	**59.98**

Table 2.9 Provisional cost of waste disposal 2006/07

Final Disposal of household waste *(including landfill tax)*	Overall amount landfilled	Overall cost of disposal	£/ tonne
Lincolnshire County	365,537	£17,270,000	**£47.25**

[7] Data provided directly by Boston Borough Council

2.2 Growth rate

Two growth rates need to be carefully considered for modelling purposes, the growth in the number of households over time, and the growth of waste arisings. These two rates will impact on the overall amount of waste arising across the Partnership in the future.

2.2.1 Population and households

The overall population for Lincolnshire County was 678,700, living in 304,223 households in 2006 with an average density of 1.05 person per hectare. The population density varies greatly between the districts from 0.69 in West Lindsey to 23.98 in Lincoln City. Lincolnshire's population has increased considerably between 1991 and 2001 as can be seen in Table 2.10.

Table 2.10: Population changes between 1991 and 2001

	Population 1991	Population 2001	% Change
Boston	53,300	55,750	+ 5%
East Lindsey	117,700	130,447	+ 11%
Lincoln	84,000	85,595	+ 2%
North Kesteven	80,000	94,024	+ 18%
South Holland	67,500	76,533	+ 13%
South Kesteven	109,500	124,792	+ 14%
West Lindsey	76,500	79,515	+ 4%
Lincolnshire County	588,600	646,645	+ 10%

Population and household growth for the next 20 years need to be taken into consideration when developing the waste management scenarios to be modelled. Table 2.11 presents the growth in the number of households forecasted for the county based on the additional planned housing units in the East Midlands Regional Housing Strategy[8]. The waste strategy will need to consider the impact of additional population growth in specific areas of the county nominated as growth points (Grantham and Lincoln), and areas that are more affected than others by immigration and seasonal migration mainly linked to casual farming work and tourism.

[8] East Midlands Regional Plan –Housing Policy Justification Paper: http://www.emra.gov.uk/files/file1054.pdf

Table 2.11. Household growth for the County

	Number of HH	HH growth (%)
2006	304,223	
2007	308,173	1.29%
2008	312,123	1.28%
2009	316,073	1.27%
2010	320,023	1.25%
2011	323,973	1.23%
2012	327,923	1.22%
2013	331,873	1.20%
2014	335,823	1.19%
2015	339,773	1.18%
2016	343,723	1.16%
2017	347,673	1.15%
2018	351,623	1.14%
2019	355,573	1.12%
2020	359,523	1.11%

2.2.2 Overall waste growth

The overall growth in waste arisings is affected by a number of factors. These vary depending on the type of waste and can include:

- GDP growth;
- Disposable income;
- Business development;
- Population increase and/or changes in population demographics;
- Changes in housing stock levels;
- Environmental legislation (e.g. Packaging and Packaging Waste Directive);
- Fiscal measures (e.g. Landfill Tax, Aggregates Levy, LATS); and
- Waste generation per household.

Consequently, unless waste minimisation activities reduce waste arisings per household at a faster rate than the growth in the number of households, overall waste arisings will continue to increase.

The total amount of municipal waste generated in Lincolnshire has increased over the last decade although the average growth rate has reduced from 6% between 1996-2001 to less than 2% between 2000 and 2007. Table 2.12 below provides a summary of waste growth trend from 2000 to 2007.

Table 2.12: Municipal Waste growth trends in Lincolnshire between 2000 and 2007

	Tonnage of MSW	% Change
2000/01	322,715	
2001/02	333,927	3.47
2002/03	339,724	1.74
2003/04	340,800	0.32
2004/05	362,662	6.41
2005/06	359,990	-0.74
2006/07	365,536	1.54
Average Rate of Change		**2.12%**

The growth rate has fluctuated considerably, with an overall reduction in municipal waste generation between 2005 and 2006. In order to make future waste growth projections, the current strategy assumes that the waste growth rate between 2000 and 2026 continues at less than 2% using a medium growth scenario. When these trends are applied municipal waste generation is assumed to reach in excess of 420,000 tonnes by 2015. Table 2.13 presents the overall waste growth taking into consideration the growth in the number of households and waste growth per household.

Table 2.13 Projected waste growth rate for Lincolnshire

	Number of households	Number of households growth (%)	Waste growth rate per HH (%)	Overall waste growth rate (%)
2006	304,223			0.7%
2007	308,173	1.30%	0.40%	1.7%
2008	312,123	1.28%	0.42%	1.7%
2009	316,073	1.27%	0.43%	1.7%
2010	320,023	1.25%	0.45%	1.7%
2011	323,973	1.23%	0.47%	1.7%
2012	327,923	1.22%	0.48%	1.7%
2013	331,873	1.20%	0.50%	1.7%
2014	335,823	1.19%	0.51%	1.7%
2015	339,773	1.18%	0.52%	1.7%
2016	343,723	1.16%	0.54%	1.7%
2017	347,673	1.15%	0.55%	1.7%
2018	351,623	1.14%	0.56%	1.7%
2019	355,573	1.12%	0.58%	1.7%
2020	363,473	1.10%	0.60%	1.7%

2.3 Development of scenarios

Any future waste management system needs to integrate all the different tiers of the waste hierarchy. However, it should be noted that there is no definitive list of 'technology mixes' available to deliver an integrated solution for managing waste, although there are a large number of possible combinations. However, detailed modelling places limitations on the ultimate number of combinations that can be tested. As a result, it is important that the range and combinations of technologies tested are on the one hand sufficiently representative of the possible scenarios, but also include consideration of the main issues and factors specific to the Partnership (e.g. projected changes in the number of households and future waste arisings).

General issues to be considered when assessing the future waste management options for the Partnership are outlined below, and are intentionally ordered to reflect each level of the Waste Hierarchy (Figure 2-2).

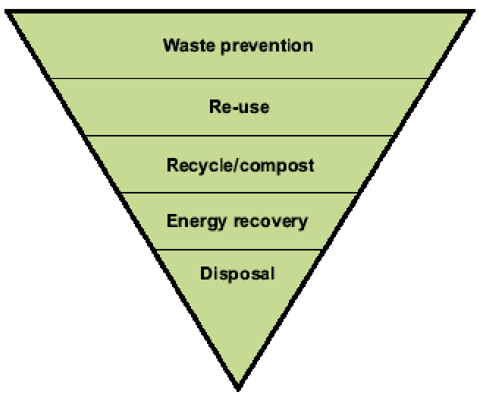


Figure 2-2: The Waste Hierarchy

These issues indicate a range of factors to be tested within the modelled scenarios. Each modelled scenario will include the following:

- Waste growth rate/ waste minimisation/ re-use
- Recycling performance, dry recycling and composting
- Appropriate residual waste treatment to meet the LATS targets

Within all the scenarios to be modelled, the recycling rate has been kept the same, i.e. to achieve a 55% recycling in 2015 across the Partnership.

The treatment of kerbside collected organic waste willl be assessed, evaluating the current technology used across the Partnership, which is windrow composting. In-Vessel Composting (IVC) could be an alternative technology, but is a more expensive technology, and so is best used when kitchen waste is co-collected with garden waste. The Partnership commitment is currently to maximise the diversion of garden waste using the current schemes. However, the Partnership will review the feasibility of kitchen waste recycling in the medium and longer term. The impact of a system that would include kitchen waste collection has been modelled on one of the best performing scenarios and can be found in section 7.5.

The main variable in the scenarios is the technology considered for the treatment of the residual waste stream in order to reduce its biodegradability content, as this will be required for the Partnership to meet its future LATS requirements.

The Partnership has identified a number of residual treatment technologies that need to be tested through the SEA assessment:

1. Landfill
2. Mechanical Biological Treatment (MBT) with aerobic stabilisation
3. Mechanical Biological Treatment with Refuse Derived Fuel (RDF) used on site in an Energy from Waste (EfW) plant
4. Mechanical Biological Treatment with Refuse Derived Fuel to a 3rd party
5. Mechanical Biological Treatment with anaerobic digestion and aerobic stabilisation
6. Mechanical Biological Treatment with anaerobic digestion and aerobic stabilisation, and Refuse Derived Fuel used on site in an EfW
7. Energy from Waste
8. Energy from Waste with Combined Heat and Power (CHP) generation
9. Advanced Thermal Treatment (ATT) – Gasification

Table 2.14 presents the scenarios modelled for the SEA. It should be noted that the Partnership has already secured a site to build a new waste treatment facility. This means that the scenarios will only consider a centralised treatment facility for the county rather a number of facilities across the County as no other sites have been secured for that purpose.

Table 2.14: Scenarios modelled in the SEA

	Overall waste Growth	Source segregated waste		Mixed Waste				
		Recycling*	Kerbside garden waste	Residual treatment	Treatment organic residuals	Use of compost	Fuel production & treatment	Landfill
1	1.7%	55% 2015	Windrow	Landfill	None	N/A	None	All waste to landfill
2	1.7%	55% 2015	Windrow	MBT	Aerobic	Stabilised output to landfill	None	Remaining waste
3	1.7%	55% 2015	Windrow	MBT	None	Stabilised output to landfill	RDF on site	Remaining waste
4	1.7%	55% 2015	Windrow	MBT	None	Stabilised output to landfill	RDF/SRF to 3rd party	Remaining waste
5	1.7%	55% 2015	Windrow	MBT	AD + Aerobic	Stabilised output to landfill	Biogas	Remaining waste
6	1.7%	55% 2015	Windrow	MBT	AD + Aerobic	Stabilised output to landfill	RDF on site and biogas	Remaining waste
7	1.7%	55% 2015	Windrow	EfW + electricity	None	N/A	N/A	Remaining waste + ash
8	1.7%	55% 2015	Windrow	EfW + CHP	None	N/A	N/A	Remaining waste + ash
9	1.7%	55% 2015	Windrow	Gasification	None	N/A	N/A	Remaining waste

Sensitivity analysis will consider the following:

- Different waste/population growth. What impact does that have?
- Failure to secure markets for RDF material to third parties.
- Impact of varying LATS values. How may the total cost of waste management change?
- Impact of current landfill contract
- Impact of introducing a kitchen waste collection

2.4 Assessment criteria

A list of criteria to be assessed within the SEA was proposed and consulted on during the scoping study consultation. The criteria can be grouped into five main categories:

- Environmental factors
- Economic factors
- Social factors
- Deliverability of waste management option
- Waste hierarchy and policy

Table 2.15 presents the assessment criteria grouped into 14 categories with the proposed weightings (please note that the categories are not in any order of priority). The 28 individual assessment criteria are provided in

Table 2.16 (environmental criteria) and Table 2.17 (other criteria).

The Partnership proposed a weighting for each of the criteria which were consulted on at the scoping stage, and again during the public consultation by a number of stakeholders. The agreed weightings after the public consultation have been used for the assessment. Table 2.15 presented the initially proposed weighting and the final agreed weightings.

Table 2.15: Criteria for assessment in 14 categories

	Criteria	**Proposed weightings (%)**	**Agreed weightings after consultation (%)**
1	Minimise **nuisance** from noise, odour, dust, litter and vermin generation	7.4%	**7.80%**
2	Minimise **local transport movements**	5.5%	**7.82%**
3	Minimise **local health** impact from waste treatment technologies	9.2%	**6.81%**
4	Minimise impact to **soil and water and air quality**	9.2%	**5.36%**
5	Help tackle **climate change** by minimising greenhouse gas emissions	9.2%	**9.77%**
6	Minimise **visual** impact	3.2%	**2.81%**
7	Maximise **resource efficiency** (land, water and other resources)	5.5%	**4.57%**
8	Minimise **costs** of waste management	7.4%	**8.61%**
9	Maximise **economic and social benefits**	6.4%	**6.33%**
10	Minimise **risks** through ensuring **maturity and flexibility of technology**	8.3%	**5.63%**
11	Maximise **public acceptability** and likelihood of obtaining planning permission	7.4%	**6.83%**
12	Ease of **public participation** and **health and safety implications**	4.6%	**5.23%**
13	Meet targets for reduction, recycling/composting and recovery	7.4%	**10.74%**
14	Meet government **targets set for diverting biodegradable waste** from landfill	9.2%	**11.70%**
	TOTAL	100%	**100.00%**

Table 2.16: Assessment of environmental criteria (unranked)

Factor		Final criteria/ objective	Measurement	Criteria
Environmental factors	Population & human health	To minimise noise level	Comparative data and/ or professional judgement *	1
		To assess extent of odour problems	Comparative data and/ or professional judgement *	
		To assess extent of dust problems	Comparative data and/ or professional judgement *	
		To assess extent of litter and vermin generation	Comparative data and/ or professional judgement *	
		To minimise local transport impacts	Total distance waste is transported per year	2
		Proximity principle and ability to close the loop locally.	Total distance waste is transported per year	
		To minimise the health impact locally from waste treatment technologies.	Human toxicity index (WRATE)	3
	Water, soil and air quality	To minimise adverse affect on water quality	Level of eutrophication (WRATE)	4
		To minimise the amount of hazardous waste landfilled	Amount of hazardous waste landfilled	
		To minimise air quality impact from waste treatment and transport emissions	Impact on local air quality (SO_2 eq.) through WRATE	
	Climate change	To reduce greenhouse gas emissions	Emission of greenhouse gases including waste treatment and transport (WRATE)	5
			Amount of energy produced through waste treatment (net of energy consumption)	
	Landscape & townscape	To minimise the visual and landscape impact	Comparative data and/ or professional judgement *	6
	Resource depletion	To ensure the prudent use of land	Total of average land take (hectares)	7
		To ensure the prudent use of water (e.g. consider potential re-circulation of water)	Total of water for treatment (m3)	
		To increase resource efficiency	Abiotic resource depletion (WRATE)	

* Comparing impact from different treatment technologies and capacities.

There are other criteria that would need to be assessed as part of a SEA for a planning document; these include impact on historic heritage, wildlife, and areas with increased flood risk. However, they were not assessed in this SEA, as the Waste Strategy is not required to identify specific locations for any new waste treatment facilities.

Table 2.17: Assessment of other criteria (unranked)

Factor	Final criteria/ objective	Measurement	Criteria
Economic factors	To minimise cost of waste management	Total cost of waste collection, waste treatment & disposal (incl. revenue from energy & products, excl income/penalties from LATS (£ over 25 years)	8
	Economic benefits generated considering new businesses and regeneration of the community.	Number of jobs generated through waste management	9
		Partnership arrangements with community recycling, community enterprises and charities and Level of new business start-ups net of closures	
Social factors	Opportunities for public involvement and education	Number of households included on collection of residual waste and measurement of effort going into promotion of recycling	
Deliverability of waste management options	To assess maturity of technology, i.e. how secure is it in future, how effective is it and what is the risk of technology failure?	Professional judgement *	10
	To assess the flexibility of the waste management system to changes in future policy, waste arisings etc.	Professional judgement *	
	To assess public acceptance and the likelihood of achieving of planning permission	Professional judgement *	11
	To assess public involvement required to achieve targets and will it be sustainable in the long-term	Participation rate required and how effective the recycling schemes have to operate to achieve recycling target. Access to recycling facilities - Number of households receiving collection for dry recyclables and organic waste	12
Waste policy	Level of waste minimisation and re-use achieved	Total waste arisings	13
	Level of recycling and composting achieved	Percentage of materials recycled and composted	
	Level of waste recovery achieved	Percentage of materials recovered	
	Level of biodegradable waste diversion from landfill achieved	Percentage of biodegradable material diverted from landfill	14

**Comparing impact from different treatment technologies and capacities.*

3 Modelling of scenarios

The evaluation of each scenario has to consider each of the 28 assessment criteria listed in

Table 2.16 and Table 2.17. AEA's in-house modelling tool (WasteFlow model) was used to assess the criteria on recycling, recovery, landfill diversion, and costs. The data and the results from WasteFlow modelling are discussed in this section. The Environment Agency's WRATE[9] software was used to assess the criteria on emissions, climate change, human health, and resource use. Other criteria (such as odour emissions) were assessed using professional judgement, as no suitable modelling tools are available.

AEA's Wasteflow model was used to:

- Model future waste arisings considering the Partnership's waste minimisation initiatives and number of households growth;
- Assess performance against recycling/composting, recovery and landfill diversion targets; and
- Calculate costs of future waste management including collection services, waste treatment and disposal.

The SEA was undertaken for a specific financial year in the long-term (2015/16). However, the performance against cost for all scenarios covers the period from 2010 to 2040, based on a typical 25 year lifetime for a treatment plant processing the Partnership's residual municipal waste stream. It should be noted that the SEA was undertaken for the Partnership overall rather than the individual districts.

3.1 Modelling of recycling and recovery

3.1.1 Source separation schemes

A household waste recycling and composting target of 55%, across the Partnership in 2015 has been determined during the public consultation and in discussion with the Partnership. The strategy objective is to achieve 55% recycling through kerbside collection of dry recyclable materials, kerbside collection of green waste, bring sites, HWRCs and potential kerbside collection of kitchen waste. Through the modelling of the scenarios, targets of 32% recycling and 23% composting countywide have been set to deliver the overall 55% recycling targets, and calculate the amount of residual waste to be treated.

A number of the collection services have recently been improved across the Partnership (with five districts running alternate weekly refuse collection), and achieving the collection rates for both dry recyclables and green waste to reach the 55% countywide recycling target should be possible with the current services in place.

To help achieve these diversion rates, the Partnership is committed to implementing an intensive and long-term education and awareness campaign. The campaign will also focus on waste minimisation and re-use, and increasing recycling performance at the HWRCs.

[9] WRATE: Waste and Resource Assessment Tool for the Environment software which replaced WISARD software in 2007

3.1.2 Specification of residual waste treatment facilities

The Environmental Agency's WRATE software (which is based on data from existing plants) was used to model:

- Mechanical Biological Treatment,
- Mechanical Biological Treatment and Anaerobic Digestion,
- Mechanical Biological Treatment and Refuse Derived Fuel
- Energy from Waste
- Advanced Thermal Technology (gasification)

Table 3.1 to Table 3.6 show the typical material and reject rates that can be expected and which have been assumed in the residual waste treatment facility modelling.

NOTE: Within the WRATE lifecycle tool, particular suppliers of waste technologies are required to be selected and consequently, the specific values stated above can vary between different suppliers. This is particularly the case for the MBT scenarios modelled.

Table 3.1: MBT-aerobic stabilisation (scenario2)

Product stream	Wt% of input feed material
Recycling (metals)	0.7
Residue to landfill	57.5
Compost stabilised to landfill	28.8
Process loss	13.0
Total	100.0

Table 3.2: MBT-RDF onsite or to 3rd party (scenario 3 and 4)

Product stream	Wt% of input feed material
Recycling (metals)	0.7
Residue to landfill	4.0
Compost stabilised to landfill	28.8
RDF onsite or to 3rd party	53.5
Process loss	13.0
Total	100.0

Table 3.3: MBT with anaerobic digestion (scenario 5)

Product stream	Wt% of input feed material
Recycling (metals)	5.0
Residue to landfill	10.0
Compost stabilised to landfill	40.8
RDF to landfill	12.5
Process loss	31.7
Total	100.0

Table 3.4: MBT with anaerobic digestion and RDF onsite (scenario 6)

Product stream	Wt% of input feed material
Recycling (e.g. metal, plastic, glass)	5.0
Residue to landfill	10.0
Compost stabilised to landfill	40.5
RDF onsite	12.5
Process loss	37.7
Total	100.0

Table 3.5: EfW incineration (scenario 7 without CHP and Scenario 8 with CHP)

Product stream	Wt% of input feed material
Metals recovered	3.0
Fly ash	3.0
Bottom ash recycled[10]	18.0
Bottom ash landfilled	6.0
Process loss	70.0
Total	**100.0**

Table 3.6: ATT- Gasification facility (scenario 9)

Product stream	Wt% of input feed material
Metals recycled	3.0
Fly ash	3.0
Bottom ash recycled[9]	18.0
Bottom ash landfilled	6.0
Process loss	70.0
Total	**100.0**

The assumed dates for starting operation of the waste management facilities in the assessed scenarios are:

- MRF - All scenarios - 2006/07
- Windrow (for green waste) – All scenarios – 2006/07
- Residual treatment facility (MBT, EfW & ATT) – Scenarios 2 to 9 – 2013/14 financial year

[10] Assumed that 75% of bottom ash is recycled as an aggregate substitute

3.1.3 Recycling, recovery and landfill diversion performance

The modelling was conducted applying the following assumptions:

- The reduced waste growth rates for municipal waste (shown in Section 2.2) are achieved;
- The recycling target (55%) set in the waste strategy for household waste is achieved
- The landfill diversion targets are met;
- The residual waste treatment facility accepts over 60% of the household residual waste, 30% of residual waste from HWRCs and all co-collected commercial residual waste;.
- The annual capacity for the residual waste treatment facility is set at a maximum of 150,000 tonnes, enough to meet and exceed landfill diversion targets, but not to treat all residual waste arisings; and.
- Current landfill contractual obligations are fulfilled.

Table 3.7 presents the recycling and recovery rates achieved for each scenario. The figures for recycling rates include metal recycled from the ATT and recyclables separated out from the MBT plants, which is why these scenarios achieve slightly higher recycling rates than the 55% set in the strategy. Metals from the EfW facility do not count towards recycling, only recovery. However, it should be noted that the Government is currently considering whether metals recovered at an EfW facility should be included in the calculation of the household waste recycling rate. It is also consulting on the inclusion of EfW bottom ash recycling and it may count towards recycling targets in future.

The stabilised output and reject product from the MBT facilities is sent to landfill and not counted as recycled or recovered. This is based on the uncertainty to secure adequate markets for the MBT output.

Table 3.7: Recycling, recovery and BMW diversion rates achieved by each scenario in 2015 (Wt %)

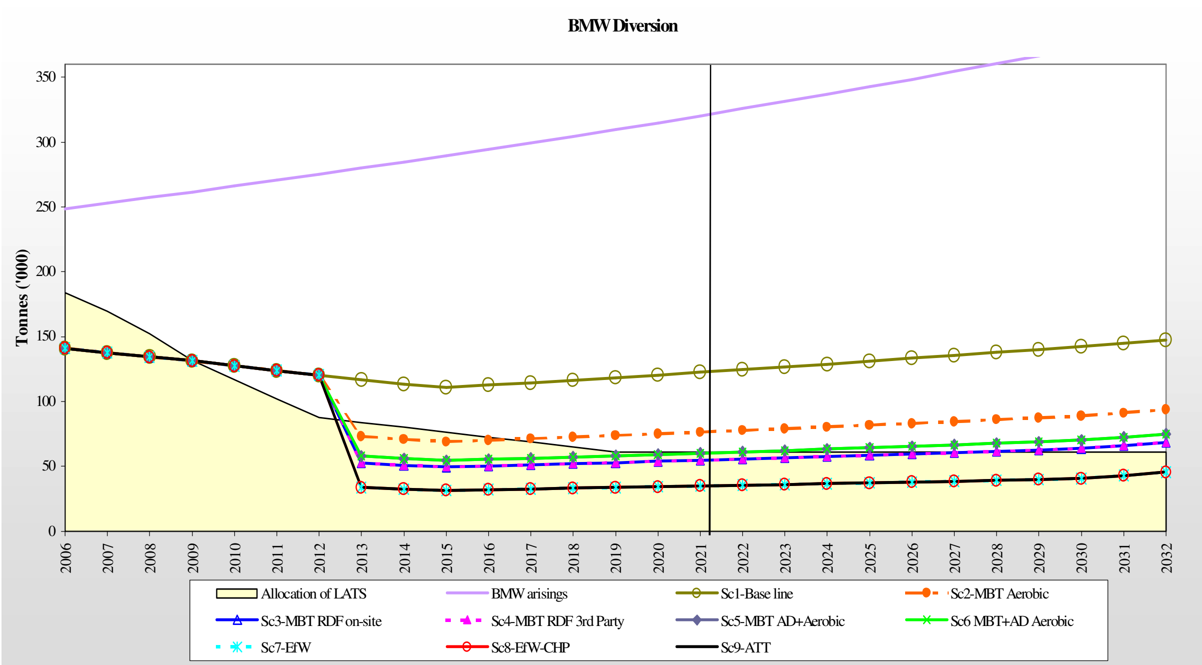
Scenario	Recycling and composting	Recovery (MSW)	BMW Diversion
Sc 1- Base Case Landfill only	55%	55%	62%
Sc 2- MBT-Aerobic	55%	59%	76%
Sc 3- MBT-RDF on site	55%	73%	83%
Sc 4- MBT-RDF to 3rd party	55%	73%	83%
Sc 5- MBT-AD + Aerobic	56%	65%	81%
Sc 6- MBT-AD + Aerobic with RDF onsite	56%	68%	81%
Sc 7 – EfW	55%	82%	89%
Sc 8 - EfW-CHP	55%	82%	89%
Sc 9- ATT Gasification	56%	82%	89%

Table 3.7 shows that:

- The MBT-AD + Aerobic scenario (5) and the MBT-AD + Aerobic and RDF on site scenario (6) achieve the highest household waste recycling rate. This is because of the additional materials (plastics and metals) that are extracted during the process compared to other scenarios.
- The ATT scenario (9) achieves slightly higher recycling than the EfW scenarios due to metal and glass being separated from the rest of the waste at the start of the process.
- The thermal treatment scenarios (scenarion 7, 8 and 9) achieve the highest MSW recovery rate.
- Some MBT processes achieve a lower waste recovery rate because of the amount of stabilised organic output and rejects from the MBT processes that is landfilled.
- All scenarios, except Base Case scenario (1), achieve high BMW diversion, with the thermal treatment achieving the highest.

Figure 3-1 shows the projected impact each scenario will have on the Partnership's ability to meet landfill diversion targets in the future.

Figure 3-1: Landfill diversion of biodegradable municipal waste



It shows that:

- Despite high recycling and composting rates, Lincolnshire will not meet any of its LATS targets post 2009/10 without further residual waste treatment.
- The further improvement of recycling and composting systems does significantly reduce the biodegradable waste landfilled, but at insufficient levels to achieve LATS targets with recycling and composting alone.
- Only the introduction of some form of residual waste treatment facility can allow LATS targets to be met in the medium and long-term.
- The thermal treatment scenarios (scenarios 7, 8 and 9) achieve higher diversion levels of biodegradable waste than the MBT scenarios. This is due to the rejects from the MBT plants, which contain biodegradable material, which are landfilled. The EfW and

ATT facilities do not produce any biodegradable material that requires landfill disposal. Bottom ash is produced which is classed as an inert material that can either be recycled or sent to landfill without contributing to the LATS penalties.

- The MBT scenarios (scenarios 2 to 6) achieve better biodegradable waste diversion rates from landfill than Scenario 1 (Base Case), because organic material is biologically treated in order to reduce biodegradability.
- The MBT - Aerobic scenario (2) diverts lower levels of biodegradable waste compared to the other residual treatment scenarios. This is due to the larger quantity of rejects, and stabilised output being sent to landfill with this type of process. This scenario does not allow LATS targets to be met.
- The Base Case scenario (1) performs poorly at diverting biodegradable waste from landfill as only the source separated recycling and composting activities help to reduce the amount of biodegradable waste being landfilled.

The modelling has assumed that a market for the RDF produced from MBT scenario 4 can be secured. However if this fails to materialise the RDF will need to be landfilled, adding to the amount of biodegradable waste that requires landfill disposal from this type of process. Within the sensitivity analyses performed (Section 7), the impact of markets for the RDF has been addressed.

3.2 Cost of waste management

The total long-term (2010 to 2035) waste management costs have been calculated using the Discounted Cash Flow technique (DCF) to compare the costs for each scenario on a like-for-like basis. While the DCF technique is a convenient tool for comparative purposes, it is not the way in which financing for a specific project is determined (this is because issues of risk allocation to contracts, levels of debt/equity and other such factors are not considered).

For a given discount rate the gate fee is calculated to equate to the net present value of future costs (capital and operating) combined with the net present value of revenues (from power sales, recyclables). A discount rate of 6% has been used for the purposes of this analysis, which is a competitive rate, compensating for some of the development costs not explicitly included in our analysis. The discount rate chosen reflects the average cost of capital for the project; it is a real discount rate i.e. inflation has been assumed to affect all cash flows to the same extent, enabling it to be excluded from the analysis.

The modelling of costs has been conducted using the following assumptions:

- No additional costs for education initiatives have been included. However, awareness campaigns to help achieve the targets for waste minimisation and recycling/composting may add significantly to the collection costs for all scenarios, as a high recycling/composting rate is assumed for all of them.
- For the ATT scenario (9), income from ROCs[11] has been included. Even though the EfW – CHP scenario (8) would also qualify for ROCs payments, it is much more difficult to estimate how much income would be generated from CHP as a number of parameters need to be considered. Consequently, the income from ROCs could vary significantly for Scenario 8 and has been excluded from the estimated costs for this scenario. However, any potential income from ROCs would reduce the total waste management costs for Scenario 8 and this must be borne in mind when considering the data presented here.
- New residual waste treatment facilities will be fully operational in the financial year 2013/14.
- The total treatment/disposal costs include the costs for the transport of the residual waste to the management facility and the movement of rejects to landfill or products to a 3rd party.
- Landfill tax remains at £48 per tonne for active waste and £2.50 per tonne for inactive waste after 2010/11 (the 2007 budget only provided details of tax to 2010/11).
- The landfill disposal cost is £17.9 per tonne in 2007/08 and then increases up to £19.9 per tonne in 2015/16, aimed at taking into account the increasing scarcity of landfill.
- The following costs per tonne have been assumed for HWRCs, waste transfer stations, MRFs and windrow composting:
    - HWRCs = £15/tonne
    - Waste transfer stations = £16/tonne from 2006 increasing to £20/tonne from 2008
    - MRFs = £33/ tonne
    - Windrow composting = £16/tonne from 2006 increasing to £25/tonne from 2009
- RDF sent to a 3rd party incurs a cost of £75 per tonne, which has been included within the gate fees for scenario 4.
- The potential costs of not achieving the LATS targets, or the potential income generated from selling additional allowances is set at £50 per tonne for all future years.

[11] ROCs: Renewable Obligation Certificates

It is important to remember that the costs/income set for LATS are average allowance values and so actual trade values will be above and below these figures. Beyond 2019/20 the BMW target is set at the final LATS target tonnage (2019/20).

Table 3.8 presents capital costs (discounted over the typical operating life of the plant), operating costs and revenues obtained from the sale of energy and recyclable materials for the modelled residual waste treatment facilities in each scenario. The annual cost for the facility includes paying off the capital, regular maintenance costs, and transport of rejects or product. The annual costs do not include potential income or the cost to landfill of any residual waste.

Table 3.8: Capacity, estimated capital and annual operational costs for residual treatment

Scenario	Facility type	Capacity (ktpa)	Estimated capital expenditure (£m)	Annual Opex in 2015/16 (£m)	Annual revenue in 2015/16 (£m)
2	MBT-Aerobic	150	27.5	3.2	0.02
3 & 4	MBT	150	45.7	7.3	0.02
3	EfW (for RDF)	75	63.7	8.2	3.9
5 & 6	MBT-AD+Aerobic	150	56.5	3.7	0.68
6	EfW (for RDF)	19	52.2	9.1	3.5
7 & 8	EfW-CHP	150	90.5	4.3	2.1
9	ATT	150	90.0	4.4	3.2

The following additional assumptions have been made:

- Landfill – Waste is sent to the same landfill sites across Lincolnshire that are currently used by the County Council.
- No specific sites are identified within the SEA assessment, therefore a new facility is assumed to be within Lincolnshire boundaries.
- Dry recyclates are assumed to continue to go to current utilised markets, as outlined in Table 2.6, in Section 2 above.
- The RDF produced has been assumed to travel on average 50km to a 3rd party facility for combustion (for the WRATE lifecycle assessment combustion in a cement kiln has been assumed).
-

The total waste management costs are presented in Figure 3-2 for the period from 2006/7 to 2031/32. The costs include:

- Collection costs
- HWRC operation
- MRF operation
- Windrow organic waste processing
- Residual waste treatment and disposal
- Transport to treatment and transport of products and rejects
- The potential LATS penalties and income

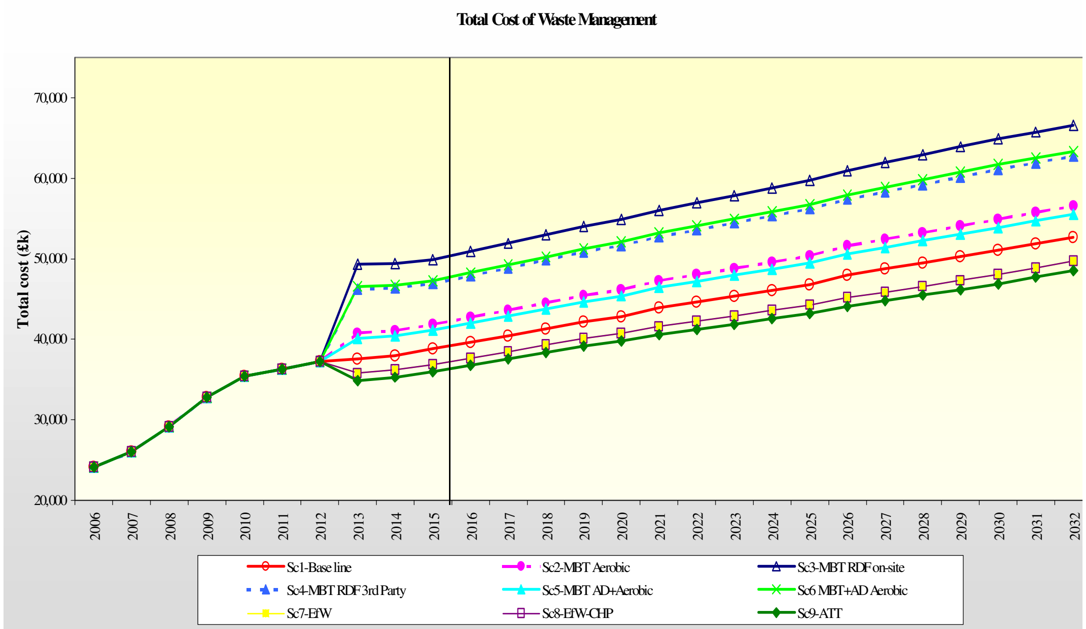


Figure 3-2: Total waste management costs (including collection and LATS)

The total costs from 2010 to 2035 (which cover the typical contract period for a treatment facility) are shown in Table 3.9.

Table 3.9: Total waste management cost (£ million) from 2010 to 2035

Scenario	Total cost (£ million)
Sc 1- Base Case	1,171
Sc 2- MBT-Aerobic	1,252
Sc 3- MBT-RDF on site	1,462
Sc 4- MBT-RDF to 3rd party	1,383
Sc 5- MBT-AD + Aerobic	1,231
Sc 6- MBT-AD + Aerobic with RDF onsite	1,395
Sc 7- EfW	1,13
Sc 8 – EfW – CHP	1,13
Sc 9- ATT Gasification	1,090

The ATT scenario (7) is presented as the least expensive option. This is due to the lower operating cost of the ATT facility, because of the additional benefits of ROCs[12] income from the energy produced. The ATT scenario also has a higher level of diversion of biodegradable waste (compared to the MBT scenarios), which results in lower landfill costs and higher income from the sale of LATS allowances until 2029/30. It should be noted that EfW - CHP scenario (8) would also attract ROCs, but this is not included in the above calculation as explained earlier. Any income from ROCs would reduce the total cost data presented here.

[12] ROC: Renewable Obligations Certificates

The EfW scenarios (7 and 8) have a relatively low cost due to high levels of diversion of biodegradable waste which results in lower landfill costs and higher income from the sale of LATS allowances.

The MBT scenarios with RDF on site (3 and 6) are the most expensive scenarios. They have the highest gate fee for a residual treatment facility and produce a significant amount of material that requires landfilling after processing, which incurs both landfill disposal and tax costs.

MBT with RDF sent to 3rd party scenario (4) has a high cost due to a relatively high gate fee which results from the high proportion of RDF material that is sent to a third party for combustion.

The MBT scenarios, which all send stabilised output to landfill, incur higher gate fees due to the relatively large amount of treated material produced needing to be sent to landfill.

The 100% landfill Base Case scenario (1) is the third least expensive option, cheaper than all the MBT scenarios.

It should be noted that there are many unknown variables that can influence the overall waste treatment and disposal cost, such as:

- Waste growth rate and whether waste reduction targets can be achieved;
- Landfill Tax increases beyond 2010/11;
- Market value and availability of LATS allowances; and
- Changes in legislation.

For example, a further increase in landfill tax rates (beyond the current maximum value of £48/tonne) will result in an increase in costs for the landfill scenario and the MBT scenarios because more biodegradable residual waste is landfilled. Thus, the cost estimates provided in the SEA, which are based on best evidence, should be seen as guidance only. The actual costs experienced by the Partnership may well be different in the future because of these variables.

4 Criteria assessment

4.1 Assessment methodology

Section 3 presented the performance against targets and costs for all scenarios. This section presents the assessment of criteria applied to environmental factors, economic factors, social factors, deliverability of scenarios and waste policy. Criteria to assess the effect of the waste strategy were defined as part of the scoping stage of the SEA and are listed in Table 2.14,

Table 2.16 and Table 2.17, in Section 2. Each criterion has been assessed by a quantitative or qualitative measure. The assessment was undertaken based on a specific year in the medium term (2015/16).

4.1.1 Measurable and non-measurable criteria

Not all criteria set for the SEA have been assigned a value in the scoring methodology for two reasons:

- Non-measurable criteria – some criteria such as 'visual impact' are not quantifiable as they are entirely subjective.
- Non-scorable criteria – some criteria, such as 'potential for business co-operation and partnership arrangements with community and charities', are potentially measurable. However, due to either the lack of data, or the quality of available data, it was decided not to score these criteria in the quantitative assessment.

The non-measurable and non-scorable criteria have been assessed using a qualitative approach, rather than a quantitative one, based on professional judgement. They have been included in the analysis of significant effects, which is presented in the next section, Section 5. Table 4.1 outlines which criteria have not been assigned a value in the quantitative assessment and the associated reasoning.

Table 4.1: Criteria not scored in the quantitative assessment

Criteria NOT scored in quantitative assessment	Comments
Environmental objectives	
To minimise the visual and landscape impact	Visual impact is entirely subjective.
Social objectives	
Potential for business co-operation and partnership arrangements with community and charities.	Some scenarios have more difficulty in achieving the recycling target as the residual treatment does not contribute to the recycling performance. Consequently more effort will be required from Lincolnshire and partners to achieve these targets. However, it is difficult to measure the effort required in relation to an achieved performance level, and this in turn depends on the initiatives set up by the Partnership with local businesses and charities.
Measurement of effort going into promotion, awareness raising and education e.g. number of school visits to promote minimisation and recycling.	The level of effort required to promote waste reduction and recycling to help achieve targets is difficult to identify. Case studies provided by WRAP outline the effort going into promotion and campaigns in specific cases, but no general guidance is available.
Deliverability of waste management option	
To assess maturity of technology, i.e. how proven/ secure it will be in the future, how effective is it and what is the risk of technology failure?	Maturity of technology depends on the status of development, its commercial use in the UK and overseas but even more on its acceptability and bankability in order to finance the waste management option.
To assess the flexibility of the waste management system to changes in future policy, waste arisings etc.	Some technologies are more flexible than others in respect of future changes in waste arisings and composition, and this is considered in the assessment.
To assess public acceptance and likelihood of achieving planning permission.	Public acceptance depends on the local area and perception of technologies.

4.1.2 Scoring methodology for quantitative assessment

The Environment Agency's WRATE software was used to assess the criteria on air, water and soil emissions, climate change, human health and resource use.

One of the limitations of all life cycle analysis (LCA) approaches, surrounds their ability to consider non-quantitative criteria (e.g. impacts on amenity value). In these circumstances, a more qualitative assessment based on judgment must be employed. As an example, the impact of the waste management infrastructure will depend on the number and type of facilities and their potential to cause nuisance. The local planning issues that need to be considered include the extent of nuisance such as noise, odour, dust, litter and vermin.

The judgement of these planning issues was carried out by ascribing performance scores to each type of treatment process depending on the type of technology and number of facilities. The scores for each planning issue have been generated by AEA through previous consultation exercises with both waste management professionals and planners, in order to derive a professional judgement on the particular facility type.

Other quantifiable values - such as total waste management costs, performance against LATS and other targets, calculation of transport impacts, amount of water consumption, land-take etc are based on the modelling of future waste arisings in Lincolnshire.

In the next step of the quantitative assessment the actual scores for each criterion have been converted to a value score by allocating a score between zero (worst performing) and one (best performing). In order to 'value' the performance of the evaluated criteria, Figure 4-1 illustrates the process of converting the criterion score to a criterion value score.

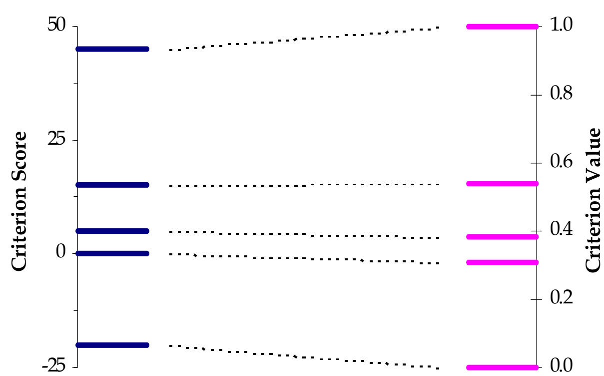


Figure 4-1: Illustration of normalising criterion scores

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, each scenario can be ranked according to performance.

The following sections present the measured scores and the normalised scores for the measured criteria, which are then used to determine the overall performance score for each scenario.

4.2 Scoring of environmental criteria

Table 4.2 presents the measured values for each environmental criterion in comparison to each scenario and Table 4.3 provides the normalised scores for these criteria. The overall performance considering all measured criteria across all scenarios is discussed below. Further detail on the scoring of each criterion is provided in Appendix A.

It should be emphasised that all results discussed in this section are based on an equal importance being placed on each criterion.

Table 4.2: Scoring of environmental objectives

	Scenario	Sc 1- Base Case	Sc 2- MBT-Aerobic	Sc 3- MBT-RDF on-site	Sc 4- MBT-RDF to 3rd party	Sc 5- MBT-AD+Aerobic	Sc 6- AD+Aerobic (RDF onsite)	Sc 7- EfW	Sc 8 EfW with CHP	Sc 9- ATT
Population and human health	Minimising noise level*	32	34	36	34	34	36	33	33	33
	Minimising extent of odour problems*	48	50	51	50	50	51	48	48	48
	Minimising extent of dust problems*	27	28	29	28	28	29	27	27	27
	Minimising extent of litter and vermin*	45	47	47	46	47	48	45	45	45
	Minimising transport impacts	3,037,628	3,592,156	3,467,492	3,592,156	3,547,882	3,518,754	3,459,332	3,459,332	3,459,332
	Minimising health impact of waste treatment	- 50,146,231	- 44,488,716	- 46,465,561	- 44,320,036	- 52,288,873	- 53,159,848	- 44,010,686	- 53,969,506	- 37,606,735
Air, water and soil	Minimising harmful emissions to water (kg PO eq.)	7,753	-11,377	- 14,292	-6,008	-2,839	-3,392	- 34,096	- 27,517	-26,819
	Minimising amount of hazardous waste produced (t)	0	0	2,493	0	0	583	3,495	3,495	3,495
	Minimising air quality impact (kg SO_2 eq.)	- 841,411	- 864,867	- 874,060	- 975,679	- 925,172	- 932,102	- 835,859	- 875,536	- 862,270
Climate change	Maximising renewable share of energy			61,833		8,738	23,185	66,060	265,638	57,438
	Minimising greenhouse gas emissions (kg CO_2 eq.)	- 101,734,763	-108,856,305	-124,788,712	-135,460,226	-126,820,410	-127,907,530	- 134,446,886	-160,328,437	-130,087,673
Resource depletion	Prudent use of land (ha)	17.84	21.76	20.95	20.95	21.12	21.05	20.28	20.28	20.28
	Prudent use of water (m^3)	0	1,165	29,214	1,165	2,330	8,884	52,429	52,429	52,429
	Prudent use of other resources (kg antimony eq.)	-1,111,189	-1,083,529	-1,299,351	-1,708,354	-1,259,665	-1,338,336	- 1,379,266	-1,614,769	-1,335,789

* performance score based on professional judgement

PO: Phosphates

SO_2: Sulphur Dioxide

CO_2: Carbon dioxide

Antimony: means that the depletion of “non-living” mineral and metallic resources are characterised such that their depletion may be presented as an equivalent mass of antimony

Table 4.3: Normalised score of environmental objectives

	Scenario	Sc 1- Base Case	Sc 2- MBT-Aerobic	Sc 3- MBT-RDF on-site	Sc 4- MBT-RDF to 3rd party	Sc 5- MBT-AD+ Aerobic	Sc 6- AD+Aerobic (RDF onsite)	Sc 7 EFW	Sc 8- EfW+CHP	Sc 9- ATT
Population and human health	Minimising noise level	1.00	0.47	0.07	0.52	0.50	0.00	0.66	0.66	0.66
	Minimising extent of odour problems	0.91	0.36	0.17	0.47	0.41	0.00	1.00	1.00	1.00
	Minimising extent of dust problems	0.95	0.53	0.22	0.68	0.60	0.00	0.99	0.99	1.00
	Minimising extent of litter and vermin	0.96	0.43	0.18	0.55	0.49	0.00	1.00	1.00	1.00
	Minimising transport impacts	1.00	0.00	0.22	0.00	0.08	0.13	0.24	0.24	0.24
	Minimising health impact of waste treatment	0.77	0.42	0.54	0.41	0.90	0.95	0.93	1.00	0.00
Air, water and soil	Minimising harmful emissions to water	0.00	0.46	0.53	0.33	0.25	0.27	1.00	0.84	0.83
	Minimising amount of hazardous waste produced	1.00	1.00	0.29	1.00	1.00	0.83	0.00	0.00	0.00
	Minimising air quality impact	0.04	0.21	0.27	1.00	0.64	0.69	0.00	0.28	0.19
Climate change	Maximising renewable share of energy	0.00	0.00	0.23	0.00	0.03	0.09	0.25	1.00	0.22
	Minimising greenhouse gas emissions	0.00	0.12	0.39	0.58	0.43	0.45	0.56	1.00	0.48
Resource depletion	Prudent use of land	1.00	0.00	0.21	0.21	0.16	0.18	0.38	0.38	0.38
	Prudent use of water	1.00	0.98	0.44	0.98	0.96	0.83	0.00	0.00	0.00
	Prudent use of other resources	0.04	0.00	0.35	1.00	0.28	0.41	0.47	0.85	0.40
Total		**8.67**	**4.98**	**4.11**	**7.73**	**6.73**	**4.83**	**7.48**	**9.24**	**6.40**
Ranking		**2**	**7**	**9**	**3**	**5**	**8**	**4**	**1**	**6**

Table 4.3 presents the scores of the scenarios on a non-weighted basis, it shows that the EfW - CHP scenario (8) achieves the highest environmental score and that the MBT scenarios with RDF onsite (scenarios 3 & 6) having the lowest environmental scores. The results show that:

- The Base Case landfill scenario (1) scores well in terms of minimising the potential for nuisance from noise, odour and dust because no processing plant is required (processing waste will generate noise, odour and dust). It should be noted that the good score achieved by the Base Case is explained by the fact that all the other scenarios it is compared to, also include a proportion of residual waste arising being landfilled, with all the associated impacts. Furthermore, this scenario does not require treatment of the residual waste, and so criteria such as land take and water use receive a high score.
- MBT with RDF to 3rd party scenario (4) comes third. It scores well on minimising air quality impact, prudent use of water and other resources.
- The thermal treatment scenarios (scenarios 7, 8 and 9) attain good scores in terms of minimising noise, litter and vermin. This is because no processing of the waste is required before it is combusted and no biodegradable waste arise from the process that would require to be landfilled. The three scenarios score the 2nd highest in transport terms (after the Base Case) due to less vehicle movements compared to the MBT scenarios, and low quantities of material requiring transport post treatment. The EfW scenario (7) and the EfW – CHP scenario (8) both score better than the ATT scenario (9) on minimising harmful emissions to water. Scenario 9 scores the worst overall on minimising health impacts.
- The MBT treatment scenarios (scenarios 2, 3, 4, 5 and 6) score well in terms of protecting biodiversity due to minimising the amount of hazardous waste that is produced and having low levels of greenhouse gas emissions. The scenarios additionally score well in the prudent use of water criteria, as a result of having no thermal combustion stage where potentially there may be high water usage for wet gas cleaning processes and for the steam raising plant. However they all, except MBT with RDF to 3rd party scenario (4) score much lower than the thermal treatment and the Base Case scenarios overall. In addition, the MBT scenarios with RDF onsite (3 & 6) score the lowest of all due mainly to a poor performance in the odour, dust, and vermin criteria.

Although each scenario scores well for some environmental criteria, they also score poorly for others:

- The Base Case scenario (1) scores poorly in terms of minimising greenhouse gas emissions due to landfilling of biodegradable waste (which will generate methane) and a lower level of energy recovery than most of the other scenarios. This leads to a higher level of resource depletion as any energy produced could be off-set against use of fossil fuels. This scenario also has higher impacts in terms of harmful emissions to water and air quality.
- The thermal treatment scenarios (scenarios 7, 8 & 9) score lower in terms of prudent use of water due to the potentially high use of water for flue gas cleaning and in the steam raising plant, and in terms of the amount of hazardous waste produced (which could have an impact on both land and water quality). They also perform less well for emissions to air.
- The MBT treatment scenarios (scenarios 2, 3, 4, 5,& 6) score poorly in terms of transport impacts due to large quantities of output material such as RDF, rejects and compost like output (CLO) needing onward transport once processed. The MBT processing operation also has the highest potential to generate noise, odour, dust and vermin, and the amount of CLO could result in water quality impacts from leachate once the compost product has been landfilled. The MBT with RDF to 3rd party scenario (4), scores the highest of all the MBT processes.

4.3 Scoring of other criteria

In order to compile an overall scoring of delivering the potential scenarios, criteria other than environmental ones need to be assessed. The other criteria cover economic and social factors, deliverability of the scenarios and waste policy.

Table 4.4 presents the measured values for each non-environmental measured criterion in comparison to each scenario and Table 4.1 provides the normalised scores. Further detail on the scoring of each criterion is provided in Appendix A.

Table 4.5 shows that the thermal treatment scenarios (scenarios 7, 8 and 9) achieve the highest scores. Of the MBT scenarios (scenarios 2, 3, 4, 5 and 6), the MBT with AD scenarios (scenarios 5 & 6) score the best. The Base Case scenario (1) is the lowest scoring option by a considerable margin. Others points to note:

- All scenarios receive a full score for minimising total waste arisings, as the same targets are set in each scenario.
- The thermal scenarios (scenarios 7, 8 and 9) also score well in terms of meeting the waste hierarchy and policy requirements because no biodegradable waste is landfilled, and they have high recovery levels. They also score well in overall cost terms due to having a low disposal/treatment cost for the residual waste, compared to MBT scenarios and the Base Case.
- The EfW scenario (7) and the EfW - CHP scenario (8) score the lowest, with the Base Case scenario (1) for recycling targets. All other scenarios have the potential to recycle slightly more waste through the residual waste treatment.
- The MBT with AD scenarios (scenarios 5 & 6) score well in terms of meeting the waste hierarchy and policy requirements because of the high recycling targets achieved.
- The MBT with AD scenarios (scenarios 5 & 6) score overall slightly better than the other MBT scenarios primarily due to greater recycling rates and employment opportunities. However, it should be emphasised that this performance depends on the MBT technology type and different technology providers may tender in the procurement process and offer alternative configurations to those assessed within this SEA.
- The Base Case scenario (1) receives the lowest score due to the lower number of jobs required at landfill sites compared to the jobs generated at a waste treatment facility. The scenario performs very poorly in all the waste hierarchy and policy requirements due to the reliance on landfill as the sole disposal route. The cost of the Base Case scenario is higher than that of the thermal scenarios, but is noticeably lower than all MBT based scenarios.

Table 4.4: Performance score for other measured criteria (economic objectives, social objectives, deliverability and waste policy)

	Scenario	Sc 1- Base Case	Sc 2- MBT-Aerobic	Sc 3- MBT-RDF on-site	Sc 4- MBT-RDF to 3rd party	Sc 5- MBT-AD+ Aerobic	Sc 6- AD+Aerobic (RDF onsite)	Sc 7- EfW	Sc 8- EfW+CHP	Sc 9- ATT
Economic objectives	Minimising cost of waste management (£ million)	1,171	1,252	1,462	1,383	1,231	1,395	1,113	1,113	1,090
	Maximising employment opportunities (jobs)	96	137	135	116	124	135	139	139	139
Social objectives	Opportunities for public involvement and education	338,345	338,345	338,345	338,345	338,345	338,345	338,345	338,345	338,345
Deliver-ability	Participation rate required	100%	100%	100%	100%	100%	100%	100%	100%	100%
Waste policy	Minimising total residual waste arisings (tons)	134,817	134,817	134,817	134,817	134,817	134,817	134,817	134,817	134,817
	BVPI recycling rate (Wt %)	55%	55%	55%	55%	56%	56%	55%	55%	56%
	MSW recovery rate (Wt %)	55%	59%	73%	73%	65%	68%	82%	82%	82%
	Percentage of biodegradable waste diverted from landfill (Wt %)	62%	76%	83%	83%	81%	81%	89%	89%	89%

Table 4.5: Normalised score for other measured criteria (economic objectives, social objectives, deliverability and waste policy)

	Scenario	Sc 1- Base Case	Sc 2- MBT-Aerobic	Sc 3- MBT-RDF on-site	Sc 4- MBT-RDF to 3rd party	Sc 5- MBT-AD+Aerobic	Sc 6-AD+Aerobic (RDF onsite)	Sc7 EfW	Sc 8 EfW - CHP	Sc 9- ATT
Economic objectives	Minimising cost of waste management (£ million)	0.78	0.57	0.00	0.21	0.62	0.18	0.94	0.94	1.00
	Maximising employment opportunities (jobs)	0.00	0.95	0.91	0.47	0.65	0.91	1.00	1.00	1.00
Social objectives	Opportunities for public involvement and education	0	0	0	0	0	0	0	0	0
Deliver a-bility	Participation rate required	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Waste policy	Minimising total waste arisings (tons)	0	0	0	0	0	0	0	0	0
	BVPI recycling rate (Wt %)	0.00	0.14	0.14	0.14	1.00	1.00	0.00	0.00	0.60
	MSW recovery rate (Wt %)	0.00	0.15	0.67	0.67	0.37	0.48	1.00	1.00	1.00
	Percentage of biodegradable waste diverted from landfill (Wt %)	0.00	0.53	0.77	0.77	0.71	0.71	1.00	1.00	1.00
Total		**1.78**	**3.34**	**3.49**	**3.26**	**4.35**	**4.28**	**4.94**	**4.94**	**5.60**
Ranking		**9**	**7**	**6**	**8**	**4**	**5**	**2/3**	**2/3**	**1**

4.4 Assessment before weighting

Table 4.6 presents the total score off all the measured criterion before weighting, which means that all the criteria have been given the same importance in this assessment. It shows that the thermal treatment options achieve the highest total scores.

The EfW-CHP scenario (8) is the highest ranked, primarily due to its CHP benefit, which shows an improved performance in environmental terms, particularly against a number of the WRATE criteria. This scenario also has a favourable scoring under the waste hierarchy and policy objectives because of its high recovery and landfill diversion performance.

The other thermal treatment scenarios (scenarios 7 and 9) score similarly overall but vary slightly in terms of environmental objectives. They both perform well overall due to a solid environmental performance, being less expensive than any of the other options and because they achieve the highest recovery and landfill diversion levels.

Overall the MBT scenarios (scenarios 2, 3, 4, 5 and 6) score lower than the thermal treatment technologies scenarios. The MBT with anaerobic digestion and aerobic stabilisation scenario (5), scores the best of all the MBT scenarios because of its lower costs and lower environmental impacts. Some of the MBT scenarios (scenarios 3 & 6) score well under the social objectives criteria because of the amount of energy recovered, and the number of jobs created through the extra facility required to burn the RDF onsite. Scenarios 2 and 3 are the lowest ranked scenarios overall, mainly due to their low scores in terms of environmental objectives, recycling, recovery and diversion of biodegradable waste from landfill.

The Base Case scenario (1) compares more favourably than some of the MBT scenarios such as scenarios 2, 3, and 6 in a number of the criteria, particularly the environmental ones. This is due to the fact that the stabilised output from the MBT scenarios is landfill which adds to the environmental impact in addition to the one arising from the MBT facility itself. However the Base Case scores poorly against social and waste hierarchy and policy objectives, mainly as a result of the continuing reliance on landfill.

As previously stated, the total scores in Table 4.6 have been calculated on the basis that all criteria have equal importance, and thus an equal weighting. However, this does not take into account the fact that the public and stakeholders may consider that some of the assessment criteria are more important than others within the local context of Lincolnshire. This issue was investigated at the Scoping Stage and during the public consultation. A number of stakeholders were asked to weight the criteria in terms of importance. These weightings have been used to re-calculate the total scores applying the agreed weightings.

Table 4.6: Total score before weighting

Scenario	**Sc 1- Base Case**	**Sc 2- MBT-Aerobic**	**Sc 3- MBT-RDF on-site**	**Sc 4- MBT-RDF to 3rd party**	**Sc 5- MBT-AD+Aerobic**	**Sc 6-AD+Aerobic (RDF onsite)**	**Sc 7 EfW**	**Sc 8-EfW+CHP**	**Sc 9- ATT**
Environmental objectives	8.67	4.98	4.11	7.73	6.73	4.83	6.94	9.24	6.40
Economic objectives	0.78	0.57	0.00	0.21	0.62	0.18	0.94	0.94	1.00
Social objectives	0.00	0.95	0.91	0.47	0.65	0.91	1.00	1.00	1.00
Deliverability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Waste policy	0.00	0.82	1.58	1.58	2.08	2.19	2.00	2.00	2.60
TOTAL	**10.45**	**8.32**	**7.60**	**10.99**	**11.08**	**9.11**	**11.88**	**14.18**	**12.00**
Ranking	**6**	**8**	**9**	**5**	**4**	**7**	**3**	**1**	**2**

4.5 Impact on score of criteria weightings

As discussed in section 2, key stakeholders were consulted at the Scoping Stage and during the public consultation on proposed weightings for the list of criteria, as it is recognised that different issues are important to different stakeholder groups. Applying the weightings to the normalised scores generates results that are more tailored to the issues important to the stakeholders and residents in Lincolnshire.

Table 4.7 presents the total scores following the application of the weightings agreed during the consultation exercises as presented in Table 2.15. The results show several changes from the un-weighted scores. However, the EfW-CHP scenario (8) still score highest, and the MBT + on site RDF scenario (3) is the least preferable option. It should also be noted that the MBT- AD + Aerobic scenarios (5), the EfW scenario (7) and the ATT scenario (9) achieved very close scores once weighted.

Table 4.7: Total un-weighted and weighted scores

Scenario	Sc 1- Base Case	Sc 2- MBT-Aerobic	Sc 3- MBT-RDF on-site	Sc 4- MBT-RDF to 3rd party	Sc 5- MBT-AD+Aerobic	Sc 6- AD+Aerobic (RDF onsite)	Sc7 EfW	Sc 8- EfW+CHP	Sc 9- ATT
Total score with weightings	**40.34**	**35.72**	**32.73**	**42.14**	**47.80**	**41.53**	**47.73**	**55.95**	**47.54**
Ranking (with weightings)	7	8	9	5	2	6	3	1	4
Total score without weightings	**10.45**	**8.32**	**7.60**	**10.99**	**11.08**	**9.11**	**11.88**	**14.18**	**12.00**
Ranking (without weightings)	6	8	9	5	4	7	3	1	2

5 Analysis of significant effects

The scoring methodology and results of the exercise presented in Section 4 are designed to compare the scenarios against each other and in doing so, effectively rank them. However, this does not assess the subjective criteria. Consequently, all the criteria are now assessed in this section against each scenario in terms of positive, negligible or negative impacts.

Although this methodology, combined with a quantitative assessment, provides a comparison, it does not evaluate the overall environmental and socio-economic significance of the scenarios, nor determine their acceptability against defined criteria. Such an assessment of acceptability may reveal that several, or all, of the proposed scenarios are acceptable, or conversely, that even the highest scoring scenario is unacceptable.

5.1 Methodology for assessing the significance of effects

The following methodology for assessing significance was developed for this SEA:

Stage 1- Definition of significance:

Under each of the generic assessment criteria groupings (e.g. social) a range of severity descriptors has been developed by which the degree of significance can be subsequently assessed. These are as follows:

- Positive (or ‘beneficial’)
- Negligible
- Negative: - *minor – moderate - major*

Table 5.1 to table 5.4 define the degree of significance in more detail.

Stage 2 – Apportioning significance:

Each waste management scenario is presented in a matrix in order to characterise, for each assessment criterion, the appropriate significance indicator for the impacts i.e. either: positive, negligible or negative. Negative impacts are further subdivided into minor, moderate or major, as indicated above. This is not intended to determine acceptability, but it does provide an overview of impacts and a visual comparison of all scenarios and all criteria considered (including measured and not measured criteria as discussed in Section 4).

Stage 3 – Assessing the results:

It is important to note that this methodology is not designed to identify the ‘best option’, rather, it presents the acceptability of a number of options against common criteria and in a transparent manner. In the case of non-measured criteria the discussion will identify any trends emerging between the nine waste management scenarios. An assessment of the results will highlight any options that are considered unacceptable on environmental and social grounds and/or as a result of stakeholder concern resulting from the public consultation exercise.

5.1.1 Stage 1 – Definition of significance

The degrees of significance of the criteria have been defined in the following tables.

Table 5.1: Degree of environmental impacts

Severity	Description
Positive	Any impacts that result in environmental improvements. These can be short- or long-term in nature and might include: Improved landscaping Reduction in emissions and discharges Energy recovery via waste treatment (e.g. AD or thermal treatment) Increased resource efficiency via the displacement of virgin material through re-use or recycling/composting. Re-use or recycling/composting (e.g. beneficial use of compost on agriculture land) No hazardous waste is generated and landfilled
Negligible	Any impacts that result in zero or no discernible environmental damage. These might include: Visual impact represented by existing facilities or new small facilities of warehouse/agricultural character with no chimney present Where water consumption is negligible due to water re-use/re-circulation Resource efficiency: limited displacement of virgin material through re-use or recycling/composting.
Negative (minor)	Slight environmental damage might include the following characteristics: Impacts are localised (within site perimeter) Impacts have a temporary (or 'short duration') and are isolated events (low probability of cumulative impacts) The effects of the impacts are reversible with (natural) recovery over a short-period of time There is zero impact on vulnerable habitats or species Potential minor effect on human health and environment if treatment technology fails to comply with regulatory limits; site improvements required Visual impact may include a small chimney on the site of the waste treatment facility No recovery of usable energy via waste treatment Resource efficiency: technology results in negligible or no displacement of virgin material through re-use or recycling/composting Water consumption is minimised with water re-use/re-circulation Very low amounts of hazardous waste are generated and landfilled

Table 5.2: Degree of environmental impacts (continued)

Severity	Description
Negative (moderate)	Moderate environmental damage which would benefit from remedial actions/ mitigation measures and would have one or more of the following characteristics: Impacts extend beyond the perimeter fence Impacts are medium-term (duration of up to 1 year) The effects of the impacts are reversible, but only in the medium-term (greater than 1 year) with some mitigation Result from cumulative effects of several (>5) minor impacts Limited impact on vulnerable habitats or species Impacts can present a nuisance to local community/individuals (<10 incidents/complaints/year) Potential moderate effects on human health and environment if treatment technology fails to comply with regulatory limits, with significant site improvements required Visual impact includes a large facility which may have a high chimney although good design and landscaping can be used to reduce the negative impact Resource consumption: technology does not support recycling and resource efficiency of material Small quantities of hazardous waste are generated and landfilled
Negative (major)	Severe environmental damage requiring remedial actions with one or more of the following characteristics: Impacts are regional (extend a number of kms from the source) Impacts are long-term (exceed a year) or permanent The effects of the impacts are not reversible and require substantial mitigation measures Result from cumulative effects of several (>5) moderate impacts; large-scale damage to common species (e.g. >5% loss of a common species) Impact to vulnerable habitat or species (e.g. Red Data Book species) Severe nuisance to local community (>10 odour incidents/year, prolonged or repeated dust problems) Potential major effect on human health and environment if treatment technology fails repeatedly to comply with regulatory limits, resulting in possible plant closure Resource consumption: technology does not support recycling and resource efficiency of materials Visual impact includes large obtrusive facility with high chimney Large quantities of hazardous waste are generated and landfilled.

Table 5.3: Degree of significance for economic and social impacts

Severity	Description
Positive	Any impacts that result in economic and social improvements - Employment opportunities - Opportunities for increasing public and business involvement in meeting waste minimisation and recycling targets
Negligible	No measurable adverse impacts
Negative (minor)	The accumulative cost of all waste management does not exceed £1,150 million for the period 2010 to 2035
Negative (moderate)	No opportunities for increasing public and business involvement in meeting waste minimisation and recycling targets The accumulative cost of all waste management is over between £1,150M and £1,350 million for the period 2010 to 2035
Negative (major)	No opportunities for increasing public and business involvement in meeting waste minimisation and recycling targets The accumulative cost of all waste management is over £1,350 M for the period 2010 to 2035

Table 5.4: Degree of significance for other project-specific criteria

Severity	Description	
Positive	Maturity of technology	Proven technology with no associated risks
	Flexibility of the technology	Fully flexible to future changes in contract and waste targets
	Public acceptance	Waste treatment infrastructure fully acceptable to the public
	Waste minimisation, recycling and recovery	Achieves all targets by 2015/16
	Waste diverted from landfill	Significantly diverts biodegradable waste from landfill exceeding 82% diversion rate
Negligible	Maturity of technology	Proven technology: good reliability and large number of reference plants operating on a similar waste stream – very low risk
	Flexibility of the technology	Flexible, but requires minor capital cost
	Public acceptance	Waste treatment infrastructure acceptable to the majority of the public
	Waste minimisation, recycling and recovery	Does not achieve targets by 2015/16: Contributes significantly to waste reduction, recycling/ composting and recovery but misses targets although it is within a reasonable range
	Waste diverted from landfill	Achieves between 77% and 82% diversion of biodegradable waste from landfill

Table 5.5: Degree of significance for other project-specific criteria (continued)

Severity	Description	
Negative (minor)	Maturity of technology	Proven technology but little experience of commercial operation in the UK
	Flexibility of the technology	Flexible, but requires moderate capital cost
	Public acceptance	Perception is that the waste treatment infrastructure may not be acceptable to the public
	Waste minimisation, recycling and recovery	Significant short-fall in achieving recovery targets by 2015/16
	Waste diverted from landfill	Achieves less than 77% diversion of biodegradable waste from landfill by 2015/16
Negative (moderate)	Maturity of technology	New technology with limited track record – moderate risk
	Flexibility of the technology	Less flexible, but requires significant capital cost
	Public acceptance	Perception is that waste treatment infrastructure is likely to be unacceptable to the public
	Waste minimisation, recycling and recovery	Small improvement on current waste minimisation, re-use, recycling/composting and recovery performance.
	Waste diverted from landfill	Significant short-fall of achieving LATS targets by 2015/16
Negative (major)	Maturity of technology	Unproven technology at development stage – high risk
	Flexibility of the technology	Inflexible; major capital cost required
	Public acceptance	Waste treatment infrastructure is not acceptable to the public
	Waste minimisation, recycling and recovery	No improvement on current waste minimisation, re-use, recycling/composting and recovery performance
	Waste diverted from landfill	Continues to landfill in future at similar levels to 2006/07 rates

5.1.2 Stage 2 – Apportioning significance

A variety of techniques can be used to present the significance of the impacts considered.

The matrix in Figure 5-1 provides an overview of significance indicators for assessing the impacts of all the assessment criteria. These are broadly categorised in terms of anticipated significance based on the professional judgement of the project team conducting the SEA, and provide a visual comparison of each scenario, independent from the scoring undertaken in Section 5. Significance is only indicative and, in reality, the actual significance or magnitude of effects is often dependent on the proximity and sensitivity of receptors to actual facilities (i.e. highly location-specific), nevertheless, it will highlight any major differences associated with the various scenarios, should they exist.

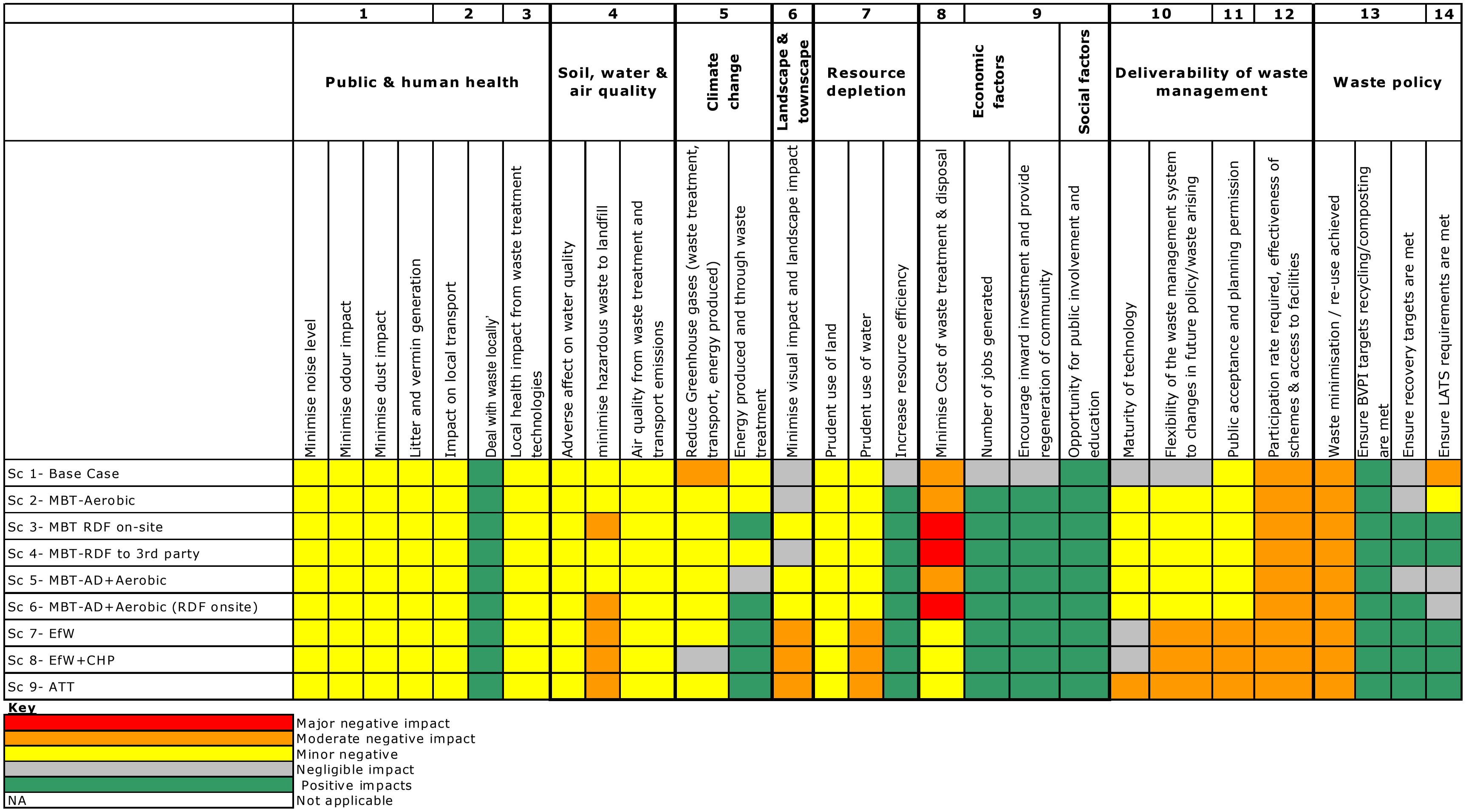


Figure 5-1: Overview of impact assessment for all scenarios

Figure 5-2 illustrates the significance of the impact for one scenario as an example. A separate matrix is provided for each scenario in Appendix C.

Whereas Figure 5-1 provides an overview of all scenarios, the individual matrices highlight specific issues and relate the significance of the effects to the scoring result for each criterion. In addition, the criteria that have not been measured in Section 4 are also assessed in the matrices and the likely degrees of significance of the impacts are shown. The apportioning of significance was undertaken for the specific scenario matrices as follows:

- Scored criteria - the degree of significance is shown for the 14 criteria categories and in relation to their normalised total scores;
- Not measured criteria – the degree of significance regarding the impact for the individual criteria are shown.

Generally, where a range of impacts are summarised under a single heading (e.g. nuisance), it is the most significant element of the summarised impact that determines the overall significance. For example, ‘nuisance’ is represented by a single point on the matrix but the term includes odour, noise, dust etc. In the event that odour is categorised as a major negative impact, but dust and noise as minor negative impacts, then the overall significance would be described as a major impact because the significance of odour overrides that of dust and noise. However, if the criteria category is split for example between minor or moderate negative impact, a tendency can also be shown by placing the category on the boundary.

The matrix gives a good visual representation of acceptability. Scenarios with markers towards the left of the matrix (positive impacts) are generally more preferable, both environmentally and socio-economically. In this methodology the following acceptability criteria are applied:

- Impacts falling in the ‘major negative’ zone are considered unacceptable and mitigation measures would be necessary to reduce the impact;
- Impacts in the ‘moderate negative’ zone are acceptable, but measures should be taken to minimise these impacts to the extent that is reasonable; and
- Impacts falling within the rest of the matrix are broadly acceptable and no, or only limited, action is required (although measures to promote positive impacts should be encouraged).

Figure 5-2 (and the matrices in Appendix C) illustrate that some low scoring impacts can in fact have low or negligible environmental/social impact. On the other hand, a scenario may score highly for a criteria category in comparison to the other criteria, but the impact may still be negative.

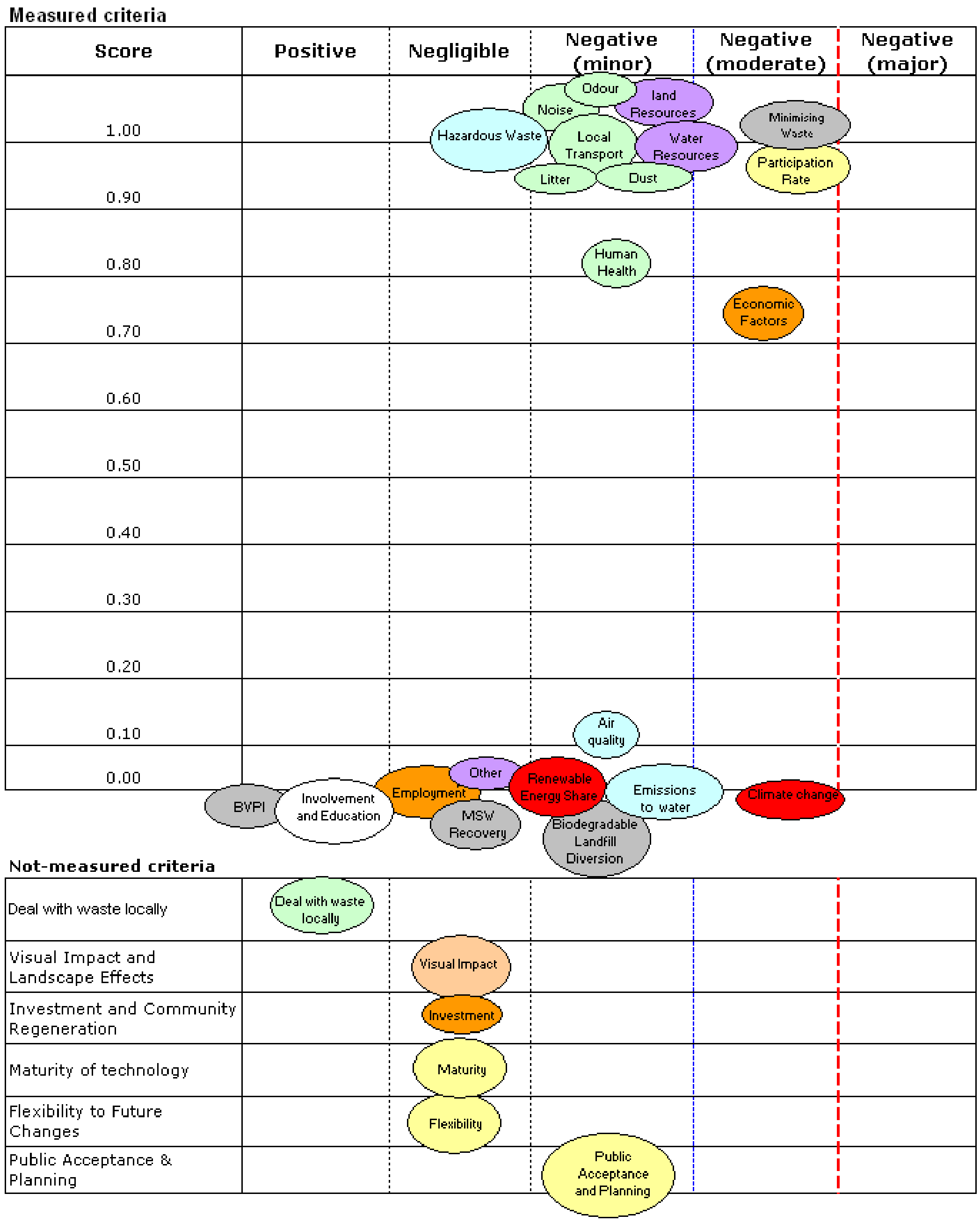


Figure 5-2: Scenario 1 Base Case – Assessment of significance

5.1.3 Stage 3 – Assessing the results

The results from the assessment show that all scenarios have some benefits, but also a number of associated issues. The right balance has to be found between accepting certain issues and gaining the most overall benefit while still ensuring that the solution is acceptable to Lincolnshire's residents and the Partnership.

The following key observations can be made from the overview matrices shown in Figure 5- and Appendix C.

<u>Major negative impacts:</u>

- The MBT with RDF scenario (scenarios 6, 4 and 3) have one potentially major negative impact, which is cost. The estimated costs are £305M, £293M and £372 million higher respectively for the period 2010 to 2035 than the cheapest alternative scenario. These additional costs may not be acceptable to the public or the Partnership. However, it should be noted that the costs provided within this SEA are only indicative and for comparison purposes. Only through a procurement exercise can the actual costs be determined.

<u>Moderate negative impacts:</u>

- All scenarios have a moderate negative impact due to the reliance on public participation to achieve certain elements. Failure to achieve targets such as recycling and waste minimisation could have implications particularly regarding the residual treatment capacity of the facility and meeting landfill diversion targets.
- The Base Case scenario (1) has two additional moderate negative impacts because it fails to meet the target for diverting biodegradable waste from landfill, which consequently impacts on greenhouse gas emissions. Furthermore, the cost of the overall scenario would have a negative impact which may not be acceptable to the public and the Partnership.
- The Base Case scenario (1) has a moderate negative impact because it does not deliver sufficient diversion of biodegradable waste from landfill to achieve the LATS targets.
- The thermal treatment scenarios (scenarios 7, 8 and 9) have a moderate negative impact for hazardous waste production because of the amount of fly ash that is produced. However, treatment and/or disposal in a suitable landfill will minimise the potential for leachate affecting soil and water quality.
- Both MBT with RDF on site scenarios (scenarios 3 and 6) have a moderate negative impact for hazardous waste production because of the amount of fly ash that will be produced from the combustion of RDF in an EfW plant.
- The thermal treatment scenarios (scenarios 7, 8 and 9) also have a moderate negative impact for public acceptance and planning permission. However, with careful design, landscaping of features and consultation with the public and stakeholders this impact can be reduced. The visual impact from thermal treatment facilities can be considerable due to the presence of a chimney. However, again, with careful design, landscaping of features and consultation with the public and stakeholders this impact can be reduced.
- The thermal treatment scenarios (scenarios 7, 8 and 9) have a moderate negative impact for water usage. All treatment technologies will consume some water during processing of waste but there is potential for water re-circulation. The thermal treatment scenarios will use a much higher quantity of water than other scenarios

because of the high level of water consumption when a wet gas cleaning process is employed.

- The ATT scenario (9) has a moderate negative impact for maturity of the technology. Both landfill and EfW are well proven technologies that have been operating commercially in the UK for many years, and are thus considered to have a negligible impact. The ATT has a limited track record. This increases the risk that the technology may not be able to deliver the targets set by the waste strategy, and thus it is classified as a moderate negative impact.
- The thermal treatment scenarios (scenarios 7, 8 and 9) scenarios have one potential major negative impact in terms of the level of flexibility within the waste management system once implemented. EfW and ATT facilities require constant operation and a throughput close to their capacity to maintain good operational practice. A reduction in tonnage could impact on energy efficiency and economic performance.

All waste treatment technologies have to comply with regulatory limits and regular monitoring would be undertaken and controlled by the Environment Agency. There would therefore be no impact on human health or the environment under normal working conditions.

<u>Minor negative impacts</u>

- All scenarios have minor negative impacts for the following criteria; nuisance (noise, odour & dust, litter and vermin) and emissions to water.
- All scenarios have a minor negative impact for land take. Land will be required for managing waste, but the amount will be small in comparison with other demands for land, such as housing and retail facilities.
- All scenarios have a minor negative impact for human health because of the perceived health impacts due to treatment of any waste product (and a resulting higher level of public opposition to such a facility). However, there should be no impact on human health if the combustion facilities comply with regulatory limits and it should be emphasised that all waste management facilities, including thermal treatment, are strictly controlled and regulated by the Environment Agency
- All MBT scenarios (scenarios 2, 3, 4, 5 and 6) have a minor negative impact for flexibility of the waste management system as they are likely to adapt slightly better than EfW and ATT technologies to change, particularly with regard to quantities of residual waste.
- The MBT scenarios (scenarios 2, 3, 4, 5 and 6) have a minor negative impact for maturity of the technology. The MBT technologies have proven operational facilities in a number of European countries, but there are a lower number of established plants in the UK. This increases the risk that the technology may not be able to deliver the targets set by the waste strategy, and thus it is classified as a minor negative impact.
- All scenarios have a minor negative impact regarding obtaining planning consent because of the likely public perception of new waste treatment facilities.
- All the scenarios have a minor negative impact for local transport despite some variation in total movements. The impact is likely to be small when compared to other traffic movements. The potential impacts on congestion would be reduced if the majority of traffic movements occurred when the level of other traffic was lower.
- The MBT-Aerobic scenario (2) has a minor negative impact for meeting LATS has is fell short of meeting the 2020 LATS target.

Negligible impacts

- The negligible impacts are predominantly assigned to the Base Case scenario (1) due to minimal changes occurring and consequently limited impact on any of the criteria.
- The EfW – CHP scenario (8), has a negligible impact on greenhouse gas emissions, because minimal amounts of waste are sent to landfill compared to other scenarios, and due to the higher energy efficiency.
- The Base Case scenario (1), the MBT-Aerobic scenario (2) and the MBT – RDF to 3rd party scenario (4) all have a negligible visual impact due to the simpler plant layouts and design features.
- The MBT – AD with Aerobic scenario (5) and MBT- AD + Aerobic (RDF on site) scenario (6) have a negligible impact for meeting the LATS targets. Both scenarios meet the 2020 LATS target, but don't meet the BMW diversion required as of 2023.
- The MBT scenarios (scenarios 2, 3, 4, 5 and 6) and the Base Case scenario (1) have negligible impact for hazardous waste as none is generated by the processes.

Positive impacts:

- All scenarios except the Base Case scenario (1) have positive impacts for the following criteria: prudent use of resources; waste recovery and biodegradable waste diversion from landfill. These are all related since diverting biodegradable waste from landfill often entails some form of recovery, which lessens the impact on resources.
- All the scenarios except the Base Case scenario (1) have a positive impact for maximising employment opportunities because treatment plants will create more employment opportunities.
- All the scenarios have a positive impact for recycling, households provided with collection schemes, promotion of waste management activities and waste minimisation.

In summary, the Base Case scenario (1) has four impacts that are classified as moderately negative and it also has the fewest positive impacts. The MBT with RDF onsite scenario (3), the MBT with RDF to 3rd party scenario (4) and the MBT with AD and RDF onsite scenario (6) have one major negative impact due to the increased costs of waste management. The ATT scenario (9) shows the highest number of moderately negative impacts.

6 Compatibility assessment

The SEA Directive does not require an assessment of compatibility of the assessment objectives, but it is good practice to test the internal compatibility of SEA. There may be tensions between certain objectives and the compatibility assessment will highlight these problems. This will enable mitigation measures or alternatives to be considered, and thus will help to ensure that subsequent decisions for future waste management in Lincolnshire are well founded.

There are a total of 28 criteria within 14 main categories. In order to simplify the assessment, it was conducted by comparing each of the 14 main categories against each other. The normal procedure for conducting the assessment is to determine whether the two criteria being compared are either compatible, in conflict, or there is no relationship between them. Examples for each classification are shown below:

- *Compatible* – a criterion is compatible with the criterion it is being compared against (e.g. increasing recycling is compatible with diverting waste from landfill).
- *No relationship identified* – There is no easily identifiable relationship between two criteria. For example, there is no relationship between tackling climate change and minimising nuisance from dust and odour.
- *In conflict* – A criterion is in conflict with the criterion against which it was being compared. For example, dealing with waste locally would result if all facilities were located close together, however, this closeness could increase the local visual impact caused by the facilities.

As the 28 criteria are grouped into 14 categories there is a risk that conflict or compatibility might occur between the different criteria in one grouping. Consequently, two further relationships; 'partly compatible' and 'potential conflict', were also used to conduct the assessment.

Figure 6-1 presents the results of the compatibility assessment. This overview indicates that generally the majority of criteria do not impact on each other. The key findings are:

- The criterion achieving the highest number of compatible scores is 'maximising public acceptability', mainly because tackling climate change or minimising the cost of waste treatment would make the strategy more acceptable to the public. However, maximising public acceptability would be in conflict with minimising dependence on public involvement, because many residents and community and interest groups like to be involved and promote waste minimisation, re-use and recycling/composting. Consequently, a lower need to involve the public in certain areas of waste management may result in lower public acceptability of the strategy.
- The criteria for meeting targets (reduction, re-use, recycling / composting and landfill diversion) are compatible with reducing emissions of greenhouse gases, providing employment opportunities, maximising regeneration of local communities and public behaviour change. However, there are also some conflicts and potential conflicts as there will be a higher level of risk in meeting these targets if the high level of public involvement required is not achieved. Visual impact may potentially be in conflict with higher recycling/composting levels, because more facilities are required although the visual impact from potentially smaller residual treatment facilities also needs to be taken into account. In addition, higher levels of recycling/composting will result in a higher transport impact, which, however, may be mitigated if local reprocessors can be identified.

- There is compatibility between increasing opportunities for employment and meeting recycling targets. However, increasing the number of waste management jobs by collecting more waste from the kerbside and having more waste treatment and disposal facilities will increase overall waste management costs.
- Considering the environmental criteria alone there are some compatibilities and some potential conflicts. Minimising the impact on air quality will reduce emissions and this is compatible with minimising local health impacts from waste treatment plants. However, reducing transport will require all facilities to be in the local area, which will increase both the local visual impact of the facilities and increase the potential health impacts from the waste treatment plants because of the closer proximity to residents.
- The total cost of waste management is generally compatible with meeting targets of waste reduction, recycling/composting and landfill diversion. However, it should be noted that this compatibility would change into conflict if the targets cannot be met. If targets are not met, the residual treatment capacity may not be sufficient in the future and additional landfill allowances would need to be purchased. On the other hand, the cost of waste management is in conflict with maximising opportunities for public behaviour change, because education and promotional campaigns need much investment (financial and time) over a long period to raise and keep public awareness high. Furthermore, waste treatment costs are also in conflict with the flexibility of technologies and services. EfW plants may be cheaper in the long-term as they provide the security of landfill diversion. However, thermal treatment plants are less flexible to changes in waste arisings or targets.

Green	Compatible
Light green	Partly compatible
Grey	No relationship identified
White box	N/A
Yellow	Potential conflict
Red	In conflict

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Minimise nuisance from noise, odour, dust, litter and vermin generation	Minimise local transport movements	Minimise local health impact from waste treatment technologies	Minimise impact to soil, water & air quality	Tackle climate change by minimising GHG emissions	Minimise visual impact	Maximise resource efficiency through prudent use of land, water & resources	Minimise cost of waste management	Maximise economic and social benefits	Minimise risks through ensuring the maturity, effectiveness and flexibility of technology	Maximise public acceptability and planning permission	Minimise dependance on public involvement considering health and safety	Meet targets for reduction, re-use, recycling & composting, and recovery	Meet targets for diverting biodegradable municipal waste from landfill
1	Minimise nuisance from noise, odour, dust, litter and vermin generation	N/A													
2	Minimise local transport movements	No relationship identified	N/A												
3	Minimise local health impact from waste treatment tecnologies	Compatible	Potential conflict	N/A											
4	Minimise impact to soil, water & air quality	No relationship identified	No relationship identified	No relationship identified	N/A										
5	Tackle climate change by minimising GHG emissions	No relationship identified	Partly compatible	No relationship identified	No relationship identified	N/A									
6	Minimise visual impact	No relationship identified	In conflict	No relationship identified	No relationship identified	No relationship identified	N/A								
7	Maximise resource efficiency through prudent use of land, water & resources	No relationship identified	No relationship identified	No relationship identified	No relationship identified	No relationship identified	No relationship identified	N/A							
8	Minimise cost of waste management	Potential conflict	Compatible	No relationship identified	No relationship identified	No relationship identified	No relationship identified	Compatible	N/A						
9	Maximise economic and social benefits	No relationship identified	Compatible	No relationship identified	No relationship identified	No relationship identified	Potential conflict	Partly compatible	Potential conflict	N/A					
10	Minimise risks through ensuring the maturity, effectiveness and flexibility	No relationship identified	No relationship identified	No relationship identified	No relationship identified	Compatible	No relationship identified	In conflict	In conflict	No relationship identified	N/A				
11	Maximise public acceptability and planning permission	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible	N/A			
12	Minimise dependance on public involvement considering health and safety	No relationship identified	No relationship identified	No relationship identified	No relationship identified	No relationship identified	No relationship identified	No relationship identified	No relationship identified	No relationship identified	Compatible	In conflict	N/A		
13	Meet targets for reduction, re-use, recycling & composting, and recovery	No relationship identified	Potential conflict	No relationship identified	No relationship identified	Compatible	Potential conflict	Partly compatible	Compatible	Compatible	In conflict	Partly compatible	In conflict	N/A	
14	Meet targets for diverting biodegradable municipal waste from landfill	No relationship identified	Potential conflict	No relationship identified	No relationship identified	Compatible	Potential conflict	No relationship identified	Compatible	No relationship identified	Compatible	No relationship identified	In conflict	Compatible	N/A

Figure 6-1: Compatibility assessment

7 Sensitivity analysis

In a report of this nature data must be projected (e.g. annual waste growth, waste composition, growth in household numbers) with no absolute certainty of the outcome,, particularly given the medium to long-term timelines. As a result it is important to analyse the overall sensitivity of each scenario to future possible changes in key variables. The sensitivity analysis approach adopted alters one variable at a time and thereafter analyses the resulting change. In this manner the waste strategy can be monitored and reviewed by the Partnership to ensure its continuing relevance.

In the following sections sensitivity analysis has been conducted on the following:

- Impact of having an overall waste growth of 2.25% instead of 1.7%,
- Issues around securing a market for RDF material,
- Market value of landfill allowances,
- Not fulfilling existing landfill contract.
- Impact of collecting kitchen waste

7.1 Sensitivity – 2.25 % overall waste growth

The strategy assumed an overall growth in waste generation of 1.7% as a result of the number of additional households established in Lincolnshire from 2007 to 2020 plus waste growth per household. However, a growth of 2.25% per annum is reflected in recent trends in growth in consumer spending. In order to test the sensitivity of having a different overall waste growth the assumptions have been set as shown in Table 7.1.

Table 7.1: Assumptions of waste growth in SEA modelling and sensitivity analysis

	SEA modelling	Sensitivity analysis
Period	Overall growth rate	Overall growth rate
2007/08 – 2039/40	1.7%	2.25%

Table 7.2 represents the costs for the new assumptions; it indicates a significant growth in total waste management costs for all scenarios. The increase shown is mainly due to the costs of more waste being landfilled, on the assumption that the residual waste treatment facilities are unable to accept the progressively higher volumes of material. Collection cost may increase as well as more waste than anticipated needs to be collected, although this depends also on the efficiency of the collection scheme and may not show a significant effect.

Table 7.2 indicates that in these circumstances all scenarios show an increase in the overall waste management costs of between approximately £68 and £86 million for 25 years (from 2010 to 2035) compared to the standard scenarios. In general, the following observations can be made:

- The scenarios keep the same order in terms of expenditure costs compared with the overall waste growth used in the SEA modelling;
- The costs in Scenario 1 Base Case increase more significantly compared to other scenarios since the overall waste growth has a larger impact on the residual waste sent to landfill, which increases the costs from LATS penalties.

Despite the higher cost increase compared to other scenarios the assessment still indicates the lowest overall costs for the thermal treatment options.

Table 7.2 Potential impact of increased waste growth on total waste management costs for the period 2007 to 2035

Scenarios	Total Cost (£ million) Waste growth 1.7%	Total Cost (£ million) Waste growth 2.25%	Variation %
Sc1-Base line	1,171	1,252	6.83%
Sc2-MBT Aerobic	1,252	1,335	6.54%
Sc3-MBT RDF onsite	1,462	1,546	5.60%
Sc4-MBT RDF to 3rd Party	1,383	1,470	6.21%
Sc5-MBT AD + Aerobic	1,231	1,311	6.33%
Sc6-MBT AD + Aerobic (RDF onsite)	1,395	1,479	5.95%
Sc7-EfW	1,113	1,184	6.19%
Sc8-EfW-CHP	1,113	1,184	6.19%
Sc9-ATT	1,090	1,159	6.23%

The impact of a 2.25% annual waste growth would impact on the amount of BMW arising and requiring treatment. Figure 7.1 presents the BMW diversion from landfill for each scenario. It shows that a number of scenarios would fall short of meeting the LATS target for 2020. It is the case for the scenario (5) MBT – AD + Aerobic and scenario (6) MBT+AD Aerobic, and as before Base Case scenario (1) and scenario (2) MBT + Aerobic.

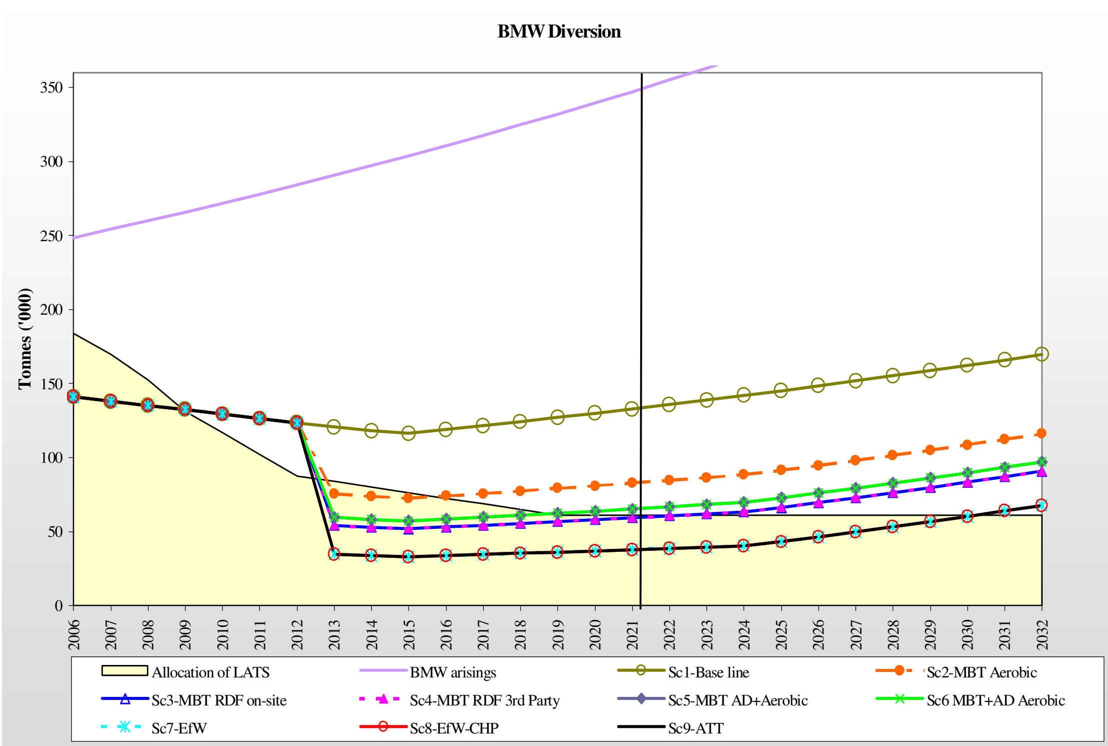


Figure 7-1: Impact of increase waste growth on BWM diversion from landfill

7.2 Sensitivity – Securing of markets for RDF

Scenario 4 MBT with third party RDF relies on a secure market for the RDF being found. However, there are uncertainties about securing a long-term market for the RDF material which must be considered.

If it is not possible to secure a 3rd party market to take the RDF material, then it will have to be landfilled. The additional material being landfilled would affect meeting Lincolnshire's BMW landfill diversion target, achievement of the LATS allowances and consequently impact on costs and professional reputation. It has been assumed that the RDF material would have a 68% biodegradable content based on a mixture of paper, plastics, and some organics. .

Figure 7-2 illustrates the revised landfill diversion performance if the RDF material from Scenario 4 was landfilled due to unavailability of outlets. This shows a significant rise in the biodegradable waste landfilled compared to the standard Scenario 4 and it would not meet the LATS allowances at any time if the RDF were to be landfilled.

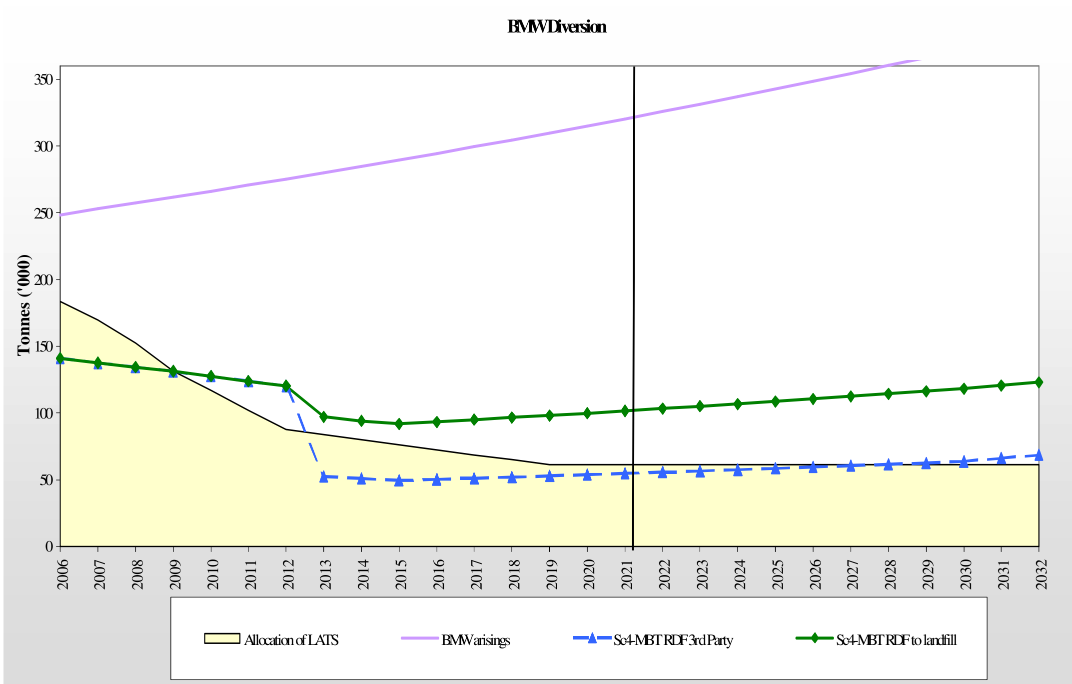


Figure 7-2: Sensitivity analysis - revised landfill diversion analysis with RDF to landfill

The impact on the treatment and disposal cost of landfilling the RDF material is shown in Figure 7-3 and Table 7.3. It should be noted that the costs of landfilling in the SEA modelling does not change for landfill tax (remains at £48/tonne beyond 2010/11) and the LATS market value was set at an estimated £50/tonne for all years (continuing with the same LATS allowances as set for 2019/20). However, the Government may increase Landfill Tax beyond 2020/11 or the LATS targets may decrease further in future (beyond 2019/20).

Table 7.3: Annual cost depending on RDF end use (£k per year)

Scenario	2012 – 2016	2017 – 2021	2022 - 2026	2027 - 2031	2032 - 2036
Sc4 MBT RDF to 3rd Party	224,046	253,954	276,965	300,673	322,161
Sc4 MBT RDF landfilled	230,637	263,062	287,601	312,827	334,559
% Change between the scenarios	2.94%	3.59%	3.84%	4.04%	3.85%

Scenario 4 increases in cost due to increased LATS costs and the additional landfill disposal and Landfill Tax cost.

The decision to landfill or secure a 3rd party market for the RDF depends on the right balance of 3rd party gate fee, cost of landfill disposal and tax and the predicted LATS performance. This needs to consider the costs of purchasing LATS as well as the potential income from sale of surplus LATS allowances (the same market value has to be assumed for purchasing and selling LATS in this SEA modelling). Furthermore, the council's determination to avoid landfill where possible also needs to be taken into account. Public perception could be that where material was landfilled, this would also represent a waste of resources.

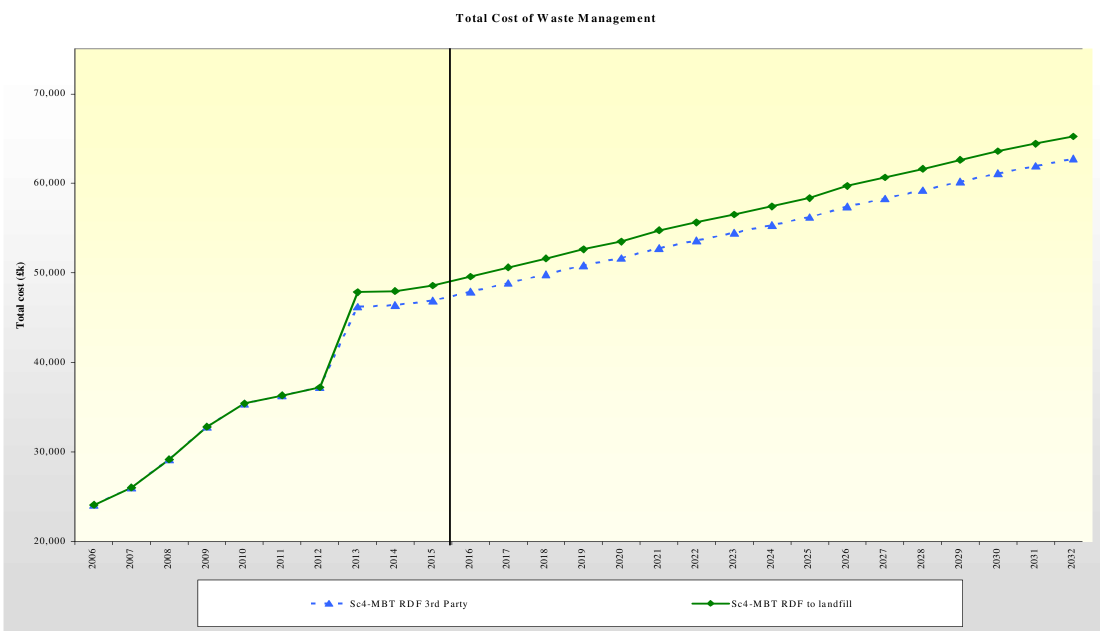


Figure 7-3: Sensitivity analysis - disposal costs with RDF sent to landfill

7.3 Sensitivity – Market value of landfill allowances

An underlying assumption of the modelling is the notional value of the tradable landfill allowance. This is difficult to estimate, because the value of allowances depends on how well other authorities achieve their diversion targets and therefore impacts on how the market will develop.

Most local authorities are expected to meet their landfill allowances in the short-term (up to 2009) through increased recycling, and borrowing and banking of allowances, hence the value is likely to be low due to less demand until 2009. In the medium term (2010-2013) landfill allowances may become more valuable as many authorities are likely to have difficulties implementing their plans for new residual treatment facilities within the required time scale and when LATS allocations are reducing substantially. Trading and landfill allowance values are likely to reduce in the long-term (2013-2020), because most authorities will plan to meet these targets and will introduce the facilities required in order to reduce the cost impacts. A notional allowance value of £50/tonne has been assumed in this modelling.

A sensitivity analysis has been undertaken to show the impact of different LATS values on the total costs of waste management (cumulative cost 2010 to 2035). In this analysis, the tradable value of landfill allowances varied between £0/tonne up to the maximum of £150/tonne as shown in

Figure 7-4. The same value has been assumed for buying and selling of landfill allowances.

Figure 7-4 indicates that the Base Line and MBT scenarios become more expensive with increasing LATS values. Only the thermal treatment scenarios (7, 8 & 9) show a decrease in their costs due to the additional income from selling LATS allowances in future.

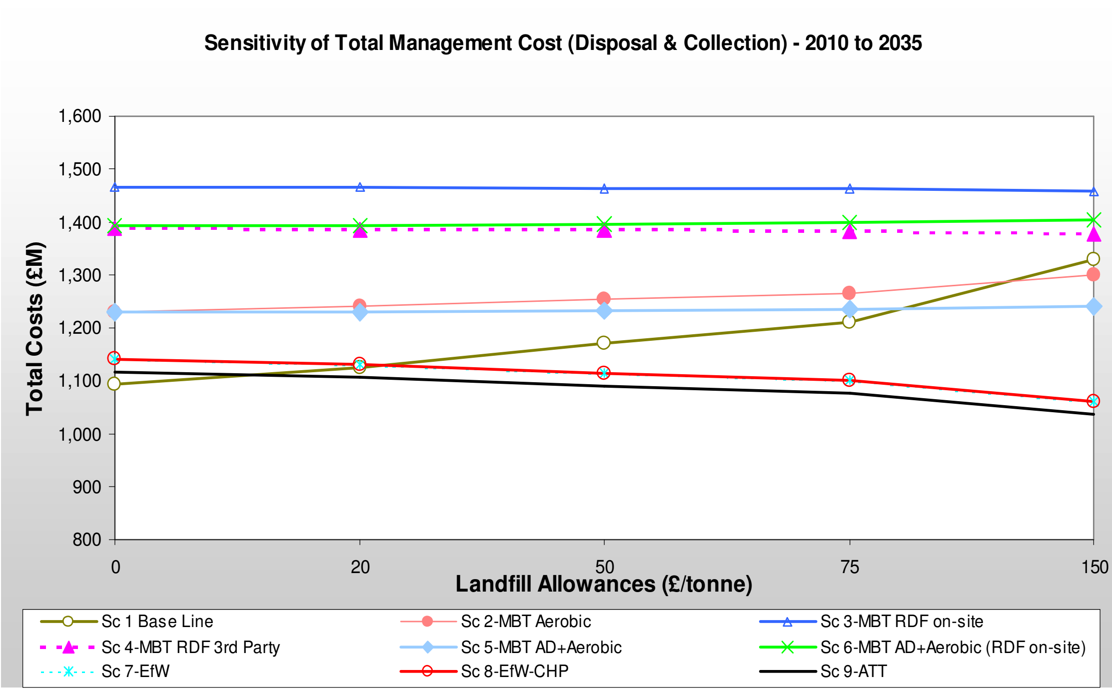


Figure 7-4: Total waste management costs under variations of LATS values

7.4 Sensitivity – Not fulfilling existing landfill contract

Under current contractual arrangements Lincolnshire County Council is obligated to deliver a specific quantity of waste to landfill sites in the county. These tonnages have been taken into consideration in the modelling.

A sensitivity analysis has been undertaken to show the impact of sending some of those tonnages to the residual treatment facility instead. Table 7.4 presents the costs for the different scenarios taking into account the new destination for some of the residual waste. They all show a decrease in total costs of between £2 and £10 million. Obviously this change does not affect scenario 1 which reflects the landfill only scenario.

Table 7.4: Total waste management costs ignoring current landfill contract against fulfilling current landfill contract

Scenario	Fulfilling LFc (£ million)	Ignoring LFc (£ million)
Sc1-Base line	1,171	1,171
Sc2-MBT Aerobic	1,252	1,246
Sc3-MBT RDF onsite	1,462	1,457
Sc4-MBT RDF to 3rd Party	1,383	1,379
Sc5-MBT AD+Aerobic	1,231	1,224
Sc6-MBT AD+Aerobic (RDF onsite)	1,395	1,390
Sc7-EfW	1,113	1,103
Sc8-EfW-CHP	1,113	1,103
Sc9-ATT	1,090	1,078

7.5 Sensitivity - Implementing kitchen waste collection

Kitchen waste represents a noticeable proportion of household waste, and the Waste Strategy 2007 identify it as a waste that local authorities need to pay particular attention to how it is collected and managed as it will contribute to England meeting its national LATS targets.

WRAP has published a number of reports on kitchen waste collection and has funded a number of pilot collections across the country. The main findings from WRAP are that two variables will significantly impact on the success of a kitchen waste collection service

- Separate kitchen waste collection or co-mingled kitchen/garden waste
- Residual waste collection frequency

The better combination appears to be a weekly separate kitchen waste collection with a fortnightly residual waste collection as outlined in WRAP's Guidance[13].

The introduction of a kitchen or food waste collection could affect the performance of the scenarios studied in the report. This section summarises the variations on the results in one of the best scoring scenarios, Scenario 7, EfW, as a result of the introduction of kitchen waste collection.

Two different options for collecting source-separated kitchen waste are considered:

- Weekly collection of separate kitchen waste
- Fortnightly collection of kitchen waste mixed with green waste

The frequency of residual waste and dry recycling collection in each district is assumed to be the same as in 2006.

For the treatment of kitchen waste, Lincolnshire County Council will need to procure, at least, one In-Vessel Composting facility. For the modelling to take into consideration transport, the location of the IVC had to be speculated. From conversation with LCC, it was agreed that the model should assume LCC procuring one IVC, which would be located at MEC Recycling in Swinderby (Lincoln).

Since the second option considers a collection of both green and kitchen waste together, the green waste has to be treated as kitchen waste in compliance with the Animal By-Product Regulations. For this option all the green and kitchen waste is assume to be sent to the IVC plant, with the exception of the green waste from the HWRC sites that is still sent to the Windrow Composting facilities throughout the County.

Several assumptions are applied in the model.

For the first option (separate kitchen waste) these are:

- Kitchen waste collection will be introduced in 2013 across the county.
- 100% household coverage.
- 60% participation rate achieved across the county.
- 26% composition of the total household waste as kitchen waste based on ELDC study. This is a relatively high percentage compare to the 19% used by WRAP, thus a sensitivity model was run using 19% matching national figures[14].

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[13] Food Waste Collection Guidance, ROTATE WRAP.
[14] Personal conversation with WRAP, 19% is based on the review of in excess of 100 waste compositional analysis funded through DEFRA.

For the second option, the assumptions are:

- Kitchen waste will be introduced in 2013.
- For districts currently collecting green waste, the number of households covered remains the same.
- South Kesteven increases its green waste coverage by an additional 6,500 households by the summer 2008 to bring the total number of households on green waste collection to 25,000 by end of 2008.
- Boston and South Holland also introduce a fortnightly green and food collection to all their households.
- The location of the IVC will require some Councils to deliver directly while others will deliver via existing transfer stations. Lincoln and North Kesteven will deliver direct; West Lindsey will transfer at Caenby Corner, East Lindsey at Louth, South Kesteven at Grantham whereas Boston and South Holland will transfer at Boston.
- 40% participation rate
- As in the first option, 26% of the total waste composition is considered kitchen waste based on ELDC study. A sensitivity model has also been run using the national for kitchen waste in household waste of 19%.
-

7.5.1 Modelling of separate kitchen waste collection

The model incorporates kitchen waste collection applying the following methodology:

- Firstly, it calculates the amount of kitchen waste collected in each of the districts by multiplying the total household waste arisings in the district by the participation rate and by the percentage of kitchen waste composition assumed.
- The tonnage of kitchen waste diverted is then subtracted from the residual waste to landfill.
- The amount of kitchen waste divided by the number of households receiving the collection and the number of weeks in a year (52) shows the Kg per household per week. Table 7.5 presents expected yield of kitchen waste collected per household per week for each of the local authorities in 2015.

It shows that:

- Systems capturing kitchen waste only achieve, in general, higher collection rates than systems capturing kitchen and green waste together.
- The kitchen waste only system would divert 51,530 tonnes of kitchen waste in year 2015, compared with 25,570 tonnes of kitchen waste collected with garden waste using a 26% kitchen waste composition
- When using the 19% composition scenario, the difference in the amount of waste diverted would be noticeable. Thus for a kitchen waste only system 37,660 tonnes would be diverted, compared with 18,690 tones for a combined kitchen and garden waste system.

Table 7.5: Collection levels in 2015

	26% comp KW only	19% comp KW only	26% comp KW & GW	19% comp KW & GW
Boston				
No households with kitchen waste	29,320	29,320	29,320	29,320
Kg/household/week	2.8	2.1	1.9	1.4
East Lindsey				
No households with kitchen waste	68,636	68,636	62,530	62,530
Kg/household/week	2.8	2	1.8	1.3
Lincoln				
No households with kitchen waste	44,162	44,162	30,835	30,835
Kg/household/week	3	2.2	2	1.4
North Kesteven				
No households with kitchen waste	51,239	51,239	48,289	48,289
Kg/household/week	3.4	2.5	2.2	1.6
South Holland				
No households with kitchen waste	41,954	41,954	41,954	41,954
Kg/household/week	2.7	2	1.8	1.3
South Kesteven				
No households with kitchen waste	62,146	62,146	27,731	27,731
Kg/household/week	2.9	2.2	2	1.4
West Lindsey				
No households with kitchen waste	42,316	42,316	13,000	13,000
Kg/household/week	3	2.2	2	1.4

7.5.2 Performance of kitchen waste collection options

Rates for recycling and composting, recovery and biodegradable waste diverted from landfill for each of the four sensitivity options are compared against the scenario without kitchen waste collection in Table 7.6:

Table 7.6: Recycling, recovery and BMW diversion rates achieved by each option in 2015 (Wt %)

Scenario	Recycling and composting	Recovery (MSW)	BMW Diversion
Sc 7- EfW	**55%**	**82%**	**89%**
Sc 7- EfW with KW (26% comp)	67%	85%	97%
Sc 7- EfW with KW (19% composition)	64%	84%	95%
Sc 7- EfW with KW+GW (26% comp)	60%	83%	92%
Sc 7- EfW with KW+GW (19% comp)	59%	83%	91%

Table 7.6 shows that:

- Systems collecting kitchen waste only have higher diversion of biodegradable waste from landfill than systems collecting kitchen and green waste together.
- The countywide recycling rate would be improve by at least 5% with a kitchen and garden waste collection and by 12% for a kitchen only system (at 26% composition)
- As it could be expected, options considering kitchen waste as 26% composition of the total waste achieve higher diversion rates than the same collection systems at 19%.

The same findings can be observed in Figure 7-4, it shows the projected impact each option will have on the Partnership's ability to meet landfill diversion targets in the future.

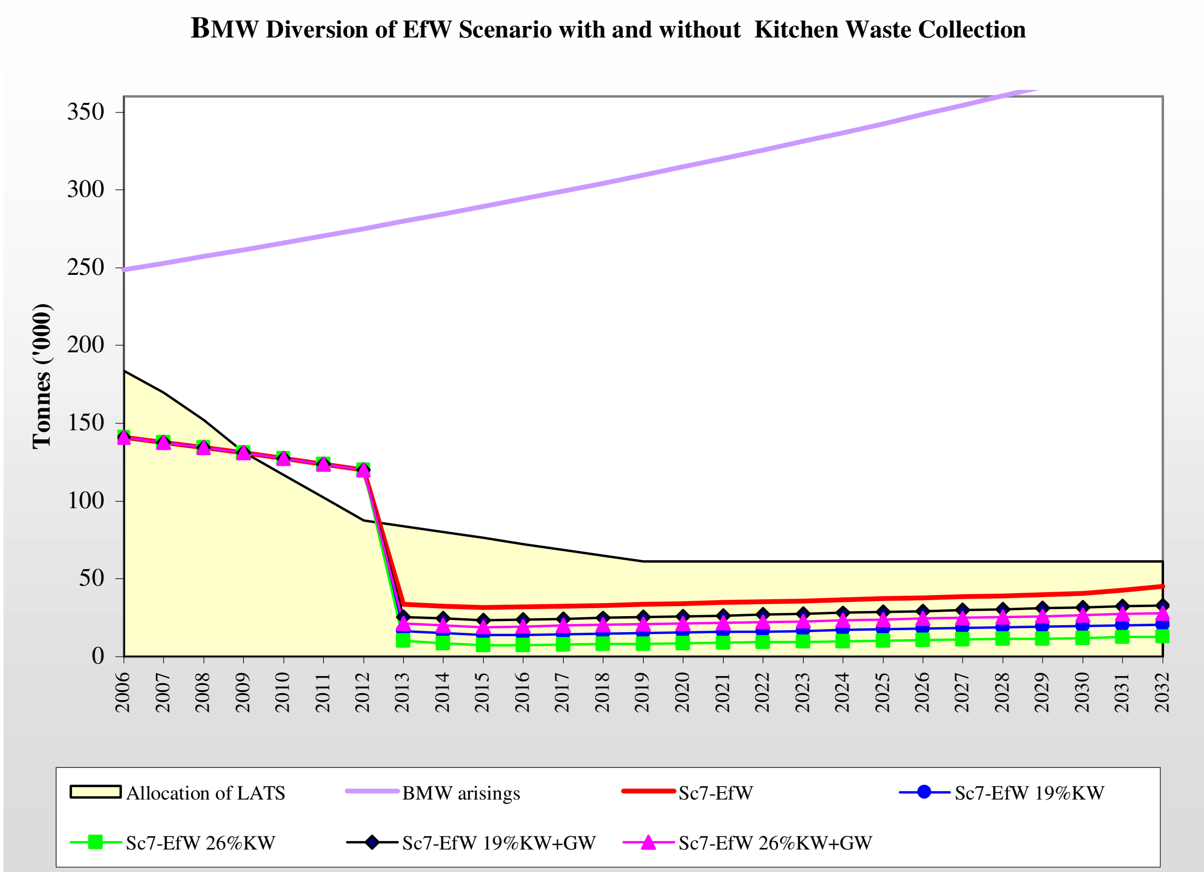

Figure 7.4: Landfill diversion of biodegradable municipal waste with a kitchen waste collection

7.5.3 Management cost of kitchen waste collection options

The total cost of the waste management system will be affected by the introduction of kitchen waste collection. The total costs for the different options from 2010 to 2035 are shown in Table 3.9

Table 7.7: Total waste management cost (£ million) from 2010 to 2035

Scenario	Total cost (£ million)
Sc 7- EfW	1,113
Sc 7- EfW with KW (26% comp)	1,187
Sc 7- EfW with KW (19% composition)	1,199
Sc 7- EfW with KW+GW (26% comp)	1,174
Sc 7- EfW with KW+GW (19% comp)	1,181

Table 7.7 shows that:

- Systems collecting kitchen waste only on a weekly basis are more expensive than systems collecting green and kitchen waste together on a fortnightly basis.
- Systems considering kitchen waste as 19% composition of the total waste are more expensive than the same systems at 26%.
- In all cases, it is more expensive to collect kitchen waste than no to collect it

The same waste management costs between options can be seen in Figure 7-3.

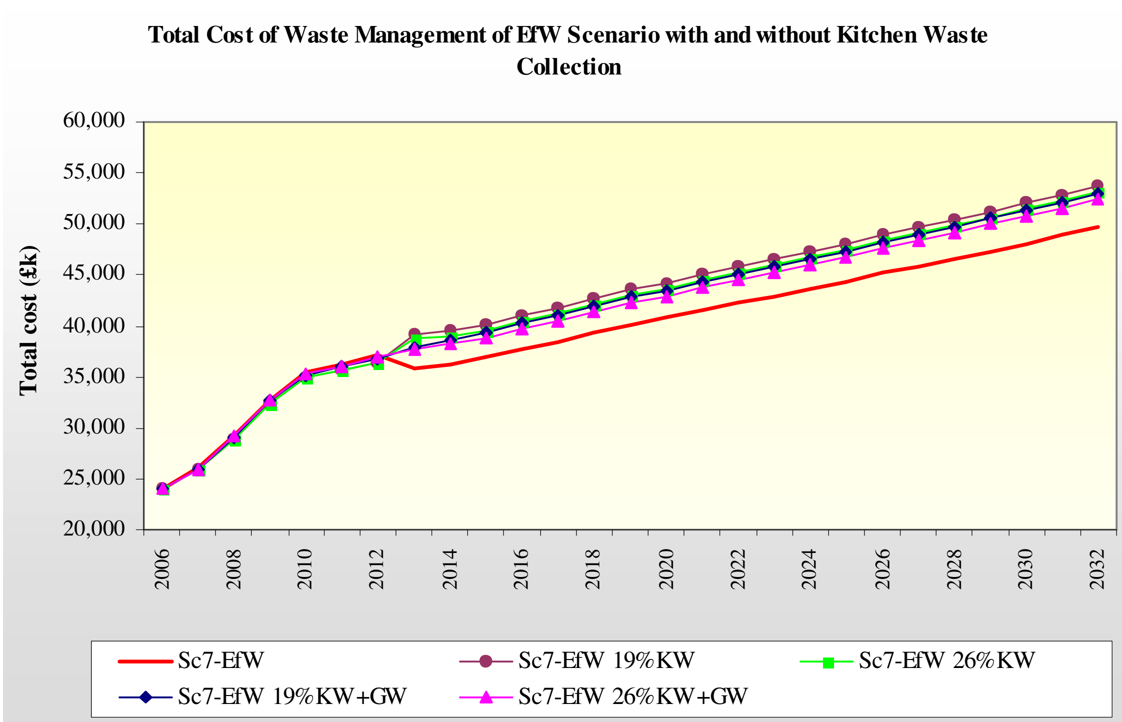

Figure 7-3: Total waste management costs (including collection and LATS)

Lastly, the sensitivity analysis considered the impact a kitchen waste would have on the Base Case scenario (1) which relies on 100% landfill to disposal of all residual waste arisings. As it can be seen in Figure 7-4 the implementation of either kitchen waste collection will not allow the County to meet its LATS targets in 2013.

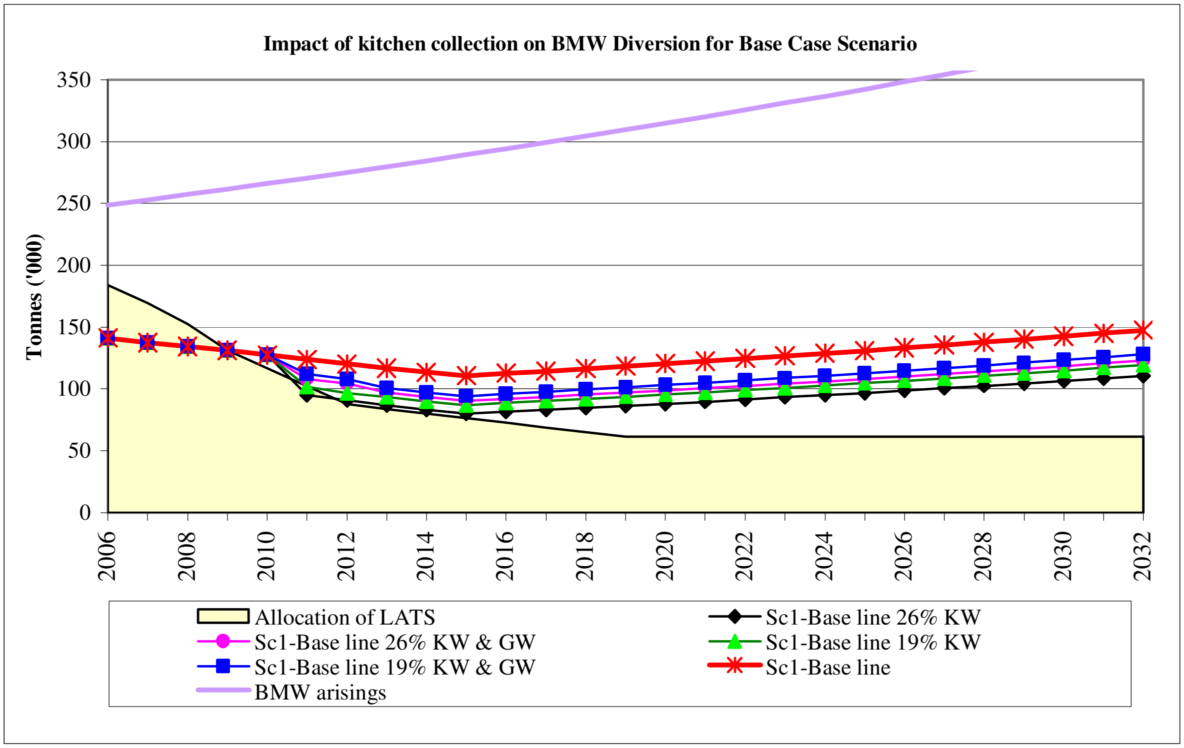

Figure 7-4 Impact of kitchen waste collection on Base Case scenario (1).

In summary, the main findings of this sensitivity analysis concentrating on kitchen waste are:

- Recycling, recovery and BMW diversion rates are higher when there is a kitchen waste collection in place. Systems with kitchen waste collected separately from green waste achieve higher diversion rates than those with kitchen and green waste together.
- The introduction of kitchen waste collection will involve extra costs for each of the districts and for the County Council. However the higher recycling, recovery and BMW diversion rate would not achieve any financial benefits, as the scenario without kitchen waste would meet both recycling and LATS targets anyway, however the environmental incentive will need to be taken into consideration.
- When collecting green and kitchen waste together, green waste has to be treated as kitchen waste increasing the costs of processing it. However, the collection costs for an extra collection service of kitchen waste make it more expensive than combining it together with garden waste. As a result, the option with kitchen waste collection only is more expensive than the collection of kitchen and green waste together.
- The same report by WRAP asserts that collection of kitchen waste and green waste in the same container is, in general, beneficial if a local authority has to cover a widespread geographical and rural area.

If a decision were taken to investigate the possibility of introducing a kitchen waste collection service, it would be prudent to undertake a new waste composition survey, since the modelling shows wide differences in the costs and environmental performances between the 26% or the 19% composition assumptions. The 26% composition is based on a survey completed in East Lindsey now more than 5 years ago. Any new survey should cover a number of districts in order to give representative data for the county.

8 Conclusions

This Environmental Report has been produced as part of an SEA to assess the impacts of Lincolnshire's Joint Municipal Waste Strategy.

A central element of the SEA has been the modelling of nine integrated scenarios for managing Lincolnshire's waste arisings: these employed different treatment technologies for organic and residual waste. While broadly representative of the residual waste treatment technologies available, these scenarios should not be taken as being definitive. It should be emphasised that the purpose of the SEA is not to promote one 'best scenario'; instead the assessment methodology enables the benefits and issues in each modelled case to be identified. In identifying its preferred waste management system, the Lincolnshire Waste Partnership will need to consider these different aspects and the inevitable 'trade-offs' that result.

The scoring methodology applied in this Environmental Report provides a comparison between scenarios, but it does not enable evaluation of the overall environmental and socio-economic significance, nor does it determine their acceptability against defined criteria. Such an assessment of acceptability may reveal that several, or all, of the proposed scenarios are acceptable, or conversely, that even the highest scoring scenario is unacceptable.

The following conclusions result from the Environmental Report **after the weighting** of the criteria.

- Scenario 7 and 8 (EfW with and without CHP) performs well, scenario 8 is the preferred option once the weighing is applied, and scenario 7 is ranked 3rd. They score highly in the environmental aspects and also highly against the waste hierarchy and policy criteria. This is because the technology provides energy recovery and produces minimal rejects requiring landfilling. The combination of these factors allows it to score well in the environmental criteria; particularly against a number of the WRATE assessed criteria. These options also score well in economic terms, being the second and third least expensive options after the ATT scenario. On the other hand, the thermal treatment scenarios score lower in terms of water usage due to flue gas cleaning and the steam raising plant, and in terms of the amount of hazardous waste produced as fly ash.

- The other thermal treatment, scenario 9 ATT, scores the second highest once weightings have been applied, and is the least expensive option. However, the ATT process has a very limited track record in processing municipal solid waste and consequently the costs are difficult to forecast with any certainty accurately predict. Additionally, as there are currently no large-scale commercial plants in operation in the UK this will impact substantially on the bankability of the technology. It should be noted that the costs provided within this SEA are only indicative and for comparison reasons. Only through a procurement exercise can the actual costs be determined. In conclusion, although the ATT scenario performs well it may not be acceptable to the County Council due to its lower maturity of technology and deliverability issues.

- Out of the MBT scenarios, scenarios 4 and 5 score better than the rest. Scenario 5 (ranked 4th), MBT with anaerobic digestion and aerobic stabilisation, scores the highest of all the MBT process because of the high recycling targets achieved. It also has the lowest cost of all the MBT scenarios.

- Scenario 4, MBT with RDF to 3rd party (ranked 5th), scores well in terms of the waste hierarchy and policy requirements. Nevertheless, it has the highest transport impact due to the transport of residues to landfill and the transport of RDF to a more distant facility.

- The MBT scenarios score poorly in terms of transport impacts due to large quantities of material needing further onward transport once processed. The MBT processing operation also has the highest potential to generate noise, odour and dust, and the higher amount of compost like output that is produced could result in water quality impacts due to leachate from the compost product once landfilled. The scenarios additionally score well in the prudent use of water criterion, since there is no thermal combustion stage.
- The Base Case landfill scenario, is ranked 6th and scores well in terms of minimising the potential for nuisance from noise, odour and dust, because no processing plant is required (processing waste will generate noise, odour and dust). Furthermore, as this scenario does not require treatment of the residual waste, criteria such as land take and water use also receive a high score. However, the scenario performs very poorly in all the waste hierarchy and policy requirements due to the reliance on landfill as a disposal route. The Base Case scenario scores poorly in terms of minimising greenhouse gas emissions due to both landfilling of biodegradable waste (which will generate methane) and a lower level of energy recovery than most of the other scenarios, which also means that there is a higher level of resource depletion (as the energy produced can be off-set against use of fossil fuels). The scenario also scores poorly in economic aspects in job creation terms.
- The scenarios with RDF combustion onsite (3 & 6), achieved the lowest ranked due mainly to a poor performance in the odour, dust, litter and vermin criteria. They also have high costs due to the additional costs of an on-site RDF combustion facility (scenario 3 is the most expensive scenario by a considerable margin). On the other hand, they score well in other areas such as energy recovery and job creation.
- The MBT with RDF to 3rd party scenario 4, scores better in terms of costs than other MBT based scenarios, however, in practical terms this is dependant upon a suitable long-term market for the RDF product being identified. The lack of a market would mean that the RDF product would need to be landfilled resulting in receiving lower scores for a number of criteria (and the additional landfill costs could result in the scenarios having a higher total cost than other scenarios).

Appendices

Appendix A: Measured Criteria

Appendix B: Not Measured Criteria

Appendix C: Scenario specific matrix

AEA Energy & Environment
From the AEA group

Gemini Building
Fermi Avenue
Harwell International Business Centre
Didcot
Oxfordshire
OX11 0QR

Tel: 0845 345 3302
Fax: 0870 190 6318

E-mail: info@aeat.co,uk

www.aea-energy-and-environment.co.uk