# Appendices

### B.5.2. Roadmap to a Resource Efficient Europe

On 20th September 2011 the EU unveiled measures to ensure waste is managed as a resource by 2020 – the commitment made in a Roadmap to a Resource Efficient Europe which defines medium and long term Europe wide objectives on resource efficiency and how the Commission plans to achieve them.

In the document the Commission calls for higher priority to be given to reuse and recycling in order to ensure that, by 2020 all waste is managed as a resource that can then be fed back into the economy as a raw material.

It makes a number of commitments including:

- by 2013/14 stimulating the secondary materials market and demand for recyclables through economic incentives and developing end of waste criteria;
- Reviewing existing targets for prevention, reuse, recycling, recovery and landfill diversion targets in 2014 to move towards an economy based on reuse and recycling;
- In 2012 consider the introduction of minimum recycled material rates, reusability criteria and extended producer responsibility for key products;
- In 2013/14 to explore the potential to align legislation on various waste streams to improve coherence;
- Continue both EU wide and international work to eradicate illegal waste shipments;
- Making sure in 2012/13 that public funding from the EU budget prioritises activities higher up the newly statutory waste hierarchy; and
- Facilitating the exchange of best practice on waste between EU member states and to take steps in 2013/14 to combat more effectively breaches of EU waste rules

The statement on reviewing targets confirms the Commission's earlier plans to review targets for packaging waste recycling and the goals set in the Waste Framework Directive in 2014, as well as indicating legislation such as the Landfill Directive could also be reviewed.

Following the publication of the roadmap the Commission plans to prepare appropriate policy and legislative measures to implement it which will then have implications on revisions being required to the appropriate UK legislation.

# Appendix C. Roles and Responsibilities

## C.1. European Union

The main role of the Environment Directorate is to initiate and define new environmental legislation, which includes policies on waste management, and to ensure that the measures which have been agreed are actually put into practice in the Member States.

## C.2. National government

The Government, through the Department for Environment, Food and Rural Affairs (Defra) and the Department for Local Government and Communities (DLGC) - [formerly known as the Office of the Deputy Prime Minister], has a number of roles to play in establishing more sustainable waste management across England and Wales. In addition to their role of encouraging voluntary action, introducing, monitoring and amending various legislative and economic instruments to encourage and enforce the safer and more sustainable management of the waste we all generate, they also have a role in raising waste awareness across all sectors of society, in encouraging the various stakeholder groups to talk (and listen) to each other with the aim of establishing waste management partnerships.

Defra has lead responsibility for waste policy and strategy while DLGC leads on planning policy issues.

## C.3. Waste collection and disposal authorities

Where two tiers of local government still exists e.g. Lincolnshire County, the Government expects both tiers to work together to achieve the following:

- Effective working relationships that will deliver a comprehensive Joint Municipal Waste Management Strategy that includes clear objectives and timescales for action;
- Put in place effective arrangements to reduce waste and maximise recycling and recovery. These should achieve the statutory performance for waste;
- Raise awareness of the costs of dealing with waste and the role that individuals can play in reducing waste;
- Involve local people in decisions on waste and work with community schemes to promote reuse and recycling; and
- Form consortia and other arrangements that will gain improved terms with re-processors and other outlets for recyclable materials.

Where single tier local government (Unitary) e.g. North Lincolnshire Council, or Metropolitan Authorities are concerned the Government still wishes to see joint working where it is appropriate to do so.

## C.4. Waste planning authorities

The Government wants Waste Planning Authorities to look to achieve a number of goals when carrying out their responsibilities of identifying suitable sites for waste facilities. The most significant of these are:

- To help to deliver sustainable development by driving waste up the waste hierarchy;
- To provide a framework in which communities take more responsibility for their own waste;
- To enable timely and sufficient provision of waste management facilities to meet the needs of communities;
- To help implement the National Waste Strategy and supporting targets;
- To support and complement other guidance and legal controls relating to waste management;

- To secure the recovery or disposal of waste without endangering human health and without harming the environment;
- To reflect the interests and concerns of communities;
- To reflect the needs of Waste Collection Authorities, Waste Disposal Authorities and business and to encourage competitiveness;
- To ensure the design and layout of new development supports sustainable waste management; and
- To protect green belts but recognise the particular locational needs of some types of waste facilities.

## C.5. Environment agency

The Environment Agency's primary role in relation to waste is to ensure that waste management activities do not cause pollution of the environment or harm to human health. The Agency also has an advisory and information gathering role. The most significant actions that the Government want the Agency to achieve in relation to improving waste management practices are to:

- Develop life-cycle techniques to help waste managers determine Best Practicable Environmental Option(BPEO);
- Use the Integrated Pollution Prevention and Control (IPPC) legislation to bring about a reduction in waste produced by industry and to ensure waste is used as a resource wherever practicable;
- Improve information on wastes accepted at waste management facilities in terms of type and source of waste; and
- Repeat the survey of industrial and commercial waste to improve information on waste.

The area occupied by North Lincolnshire currently falls within both the Anglian and Midland Regions of the Agency for regulatory purposes. However, data relating to the management of wastes arising within North Lincolnshire forms part of the Strategic Waste Management Assessment conducted by the North East Region.

## C.6. Animal health

Animal Health (AH) (formerly the State Veterinary Service) is the responsible authority for the regulation of the Animal By-Products Regulations 2003, and subsequent amendments. These regulations apply to municipal waste for any process where waste identified as catering waste is treated. The definition of catering waste includes wastes from domestic kitchens and as a result organic wastes, separately collected for biological treatment, have the potential to be included in the definition. Catering wastes require specific treatment conditions including cleaning regimes, minimum times and temperatures and enclosure if the waste is to be used on land. AH is responsible for authorising the processes that have to comply with these regulations.

## C.7. The community sector

The strengths of the community sector are in its ability to be innovative and its commitment to change. The Government wants community groups to call on these strengths in order to:

- Be fully involved in local authority efforts to build partnerships for more sustainable waste management;
- Develop partnerships with local authorities in line with published guidance; and
- Continue to motivate public involvement and participation in recycling and composting schemes.

In order to conduct an Environmental Options Assessment (EOA) on future waste management in North Lincolnshire, seven scenarios for various options for waste management were evaluated and assessed on a range of criteria based on environmental, socio-economic and operational issues. Combining these

assessments and applying weighting factors to reflect the relative importance of each criterion enabled overall scores for each scenario to be determined.

The results show that diversion of waste away from landfill and recovering value from the waste is the best option. Scenario 4 (pyrolysis/gasification) and scenario 2a (small EfW) facility) have been identified as the best options for achieving these aims. However, the technologies for pyrolysis/gasification are still being developed and there are known issues regarding public acceptance of an EfW facility. Whilst the scoring has reflected these issues, deliverability is a key issue for any waste management project. Consequently, if these solutions cannot be delivered, other options that can provide diversion away from landfill and recover value from waste material will be considered in North Lincolnshire.

The waste management solution may not necessarily be one of the scenarios which has been assessed as the modelled scenarios merely enable the key policies and issues to be considered. As well as the issues regarding implementation of either a pyrolysis/gasification or EfW facility, there are also issues regarding markets for the products that the MBT and autoclave scenarios will produce, and there will be difficulties in delivering the required waste minimisation and intensive recycling required by the high recycling scenario. Consequently, all of the issues identified by this report will need to be further considered during the procurement process for both recycling and residual treatment technologies.

# Appendix D. Small WEEE Leaflet

# Appendix E. Carbon Management Plan

# Appendix F. Options Analysis

## F.1. EOA assessment

### F.1.1. Introduction

The methodology used in the draft waste strategy document has been updated, as new information not available at the time that the draft strategy was written is available to us. The scenarios chosen have been based closely upon the experience gained in the last 4 years through the procurement projects, the due diligence and soft market testing. These are detailed below. Since the draft document was written the WISARD model has been replaced by WRATE, which is more sophisticated and transparent than WISARD. It has also been updated to version 2, including updated technologies data, incorporated in the modelling. The data from these can be filtered for a number of sustainability indicators and assessment criteria, which have been fed into the assessment process.

### F.1.2. Overall Methodology

The overall methodology adopted is the use of weighted matrix analysis to assess each of the options for a range of criteria which are given an individual score. The sum of these score gives the overall score. Because the different factors vary in importance to the Council the various criteria have been given weightings relative to each other. As is standard practice in this type of multi criteria analysis, the weightings are normalised so that they add up to 100%.

The scores for each criterion are then multiplied by each appropriate weighting to give an overall 'weighted' score. These are then compared on the final results table and graphs to give an overall assessment of the best environmental option

### F.1.3. F.1.3. Scenarios

The scenarios identified are listed below. These are based upon the local market conditions at the time of writing and are based upon the plants that are in existence or proposed within the region, and also outside of the region in the case of the large EfW plant.

Table F.1: Scenarios analysed in the options assessment

| | Name | Definition | Costs |
|---|---|---|---|
| 1 | Do nothing | Business as usual (BAU) - all materials currently landfill continue to be landfilled with growth rate proportional to the population growth predicted for the authority | Includes gate fee, transport and landfill tax |
| 2 | Regional EfW | Plant available in neighbouring area within the region | Gate fee (transport and disposal included in gate fee) |
| 3 | Autoclave Outside N Lincs | Autoclave with LF of fibre produced | Gate fee (transport and disposal included in gate fee) |
| 4 | MBT in N Lincs | Facility built in central location, providing a fuel for a cement kiln, which can be located within the County or elsewhere. | Gate fee (transport and disposal included in gate fee) |
| 5 | Large EfW | Merchant facility outside of the County at maximum practicable distance | Includes gate fee and transport (disposal included in gate fee). |

| | Name | Definition | Costs |
|---|---|---|---|
| 6 | ATT in N Lincs | Pyrolysis/ Gasification plant built within the county with central location. Capacity in the region of 80,000 tonnes per annum | Gate fee (transport and disposal included in gate fee) |
| 7 | MHT outside N Lincs | Residual waste transported to mechanical heat treatment facility within maximum radius of 50 miles (from centre of the County). | Includes gate fee and transport (disposal included in gate fee). |

These are technologies that have either been proposed through the procurement or options that have been considered at some stage in the past through independent studies or contacts with neighbouring councils. They represent the full range of viable technologies that are available at the present time or the near future. The distances that may be travelled in conveying waste has bee used to help build up the assessment and the WRATE models (see below).

In the assessment the options are score on a 1 to 10 basis on each of the criteria outlined below. These have been altered slightly since the draft document to account for the changes in the demands of the SEA process and to integrate more closely with this; however the overall changes are small. Where a particular issue has been shown to be of greater importance since the draft strategy was written a greater weighting has been given. The issues surrounding deliverability have been given a higher weighting, for example.

Table F.2: BEO assessment criteria (based upon current SEA requirements)

| Objective | Criterion | Weighting |
|---|---|---|
| 1. To ensure prudent use of land and resources | Resource depletion avoided burden in 1m year timescale (WRATE) | 4.8% |
| | Landtake (Ha) | 2.4% |
| 2. To reduce greenhouse gasses | Emissions of Greenhouse gases (WRATE) | 11.8% |
| 3. To minimise air quality impacts | Human toxicity (WRATE) | 5.6% |
| | Air acidification (WRATE) | 2.6% |
| | Ozone depletion (WRATE) | 3.7% |
| | Odour issues (WRATE) | 2.7% |
| | Dust problems (WRATE) | 2.8% |
| 4. To conserve landscapes and townscapes | Visual and landscape impacts | 4.5% |
| 5. To protect local amenity | Noise | 3.6% |
| | Litter and vermin | 2.0% |
| 6. To minimise adverse effects on water quality | Eutrophication (WRATE) | 2.6% |
| | Aquatic ecotoxicology (WRATE) | 3.4% |
| 7. To minimise local transport impacts | Transport impact (WRATE GHG) | 5.1% |
| 8. To provide employment opportunities | Number of jobs created (includes transport) | 2.4% |
| 9. To provide opportunities for local education and participation | Potential for participation in recycling/ composting and waste minimisation | 4.0% |
| 10. To minimise costs of waste management | Overall costs (£M) | 9.4% |
| 11. To ensure reliability of delivery | Maturity of technology including markets for products and bankability | 4.2% |
| | Technical delivery of the facility including planning/ permitting | 6.7% |

| Objective | Criterion | Weighting |
|---|---|---|
| 12. To conform with waste policy | Waste minimisation | 5.0% |
| | Percentage of materials recovered (%) | 5.2% |
| | Percentage of materials recycled/ composted (%) | 5.5% |
| Total | | 100.0% |

All of the scoring where indicated have been done on the basis of the WRATE analysis, which breaks down the impacts into considerable detail. Others are part of a subjective judgement or have been the result of the costs modelling outlined below.

The scoring is on the basis of best = 10, worst = 0 with the others scoring a percentage of the two scores. The weightings are then applied, and the results calculated form the sum of the individual scores for each criterion.

### F.1.4. Results

The results are shown below. They show that the MBT option scores well compared to the other scenarios modelled.

Table F.3: Final weighted scores

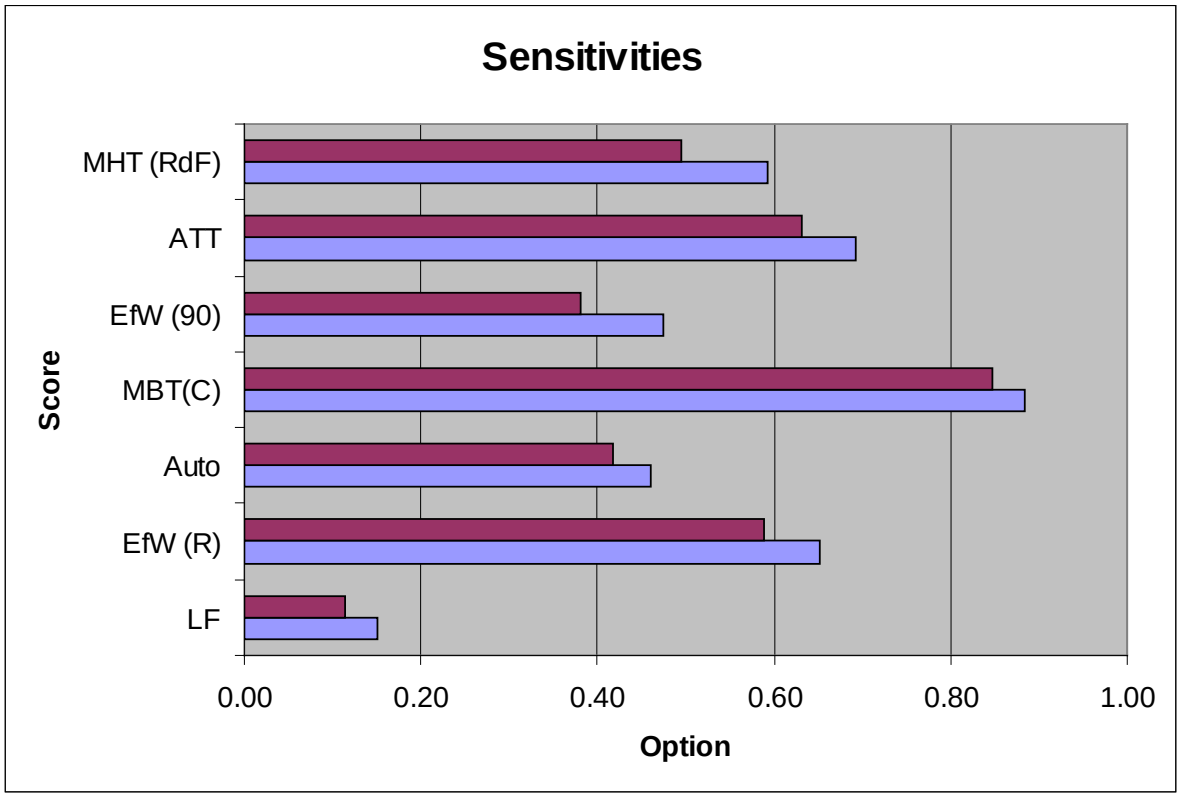
| Scenario | LF | EfW (R) | Auto | MBT(C) | EfW (90) | ATT | MHT (RdF) |
|---|---|---|---|---|---|---|---|
| Environmental | 0.10 | 0.38 | 0.32 | 0.50 | 0.26 | 0.34 | 0.38 |
| Socio-economic | 0.028315 | 0.07446 | 0.069133 | 0.158 | 0 | 0.149168 | 0.0383244 |
| Operational | 0 | 0.170633 | 0.0528 | 0.211339 | 0.170633 | 0.177694 | 0.1239245 |
| Total Score | 0.131207 | 0.62 | 0.439198 | 0.865275 | 0.428437 | 0.662247 | 0.5444439 |

### F.1.5. Sensitivity Analysis

A sensitivity analysis was carried out by varying the two criteria with the largest weightings, i.e. criteria 2 and 10 (greenhouse gas emissions and costs) by zero and double their weighting, the results are shown below.

The results indicate that the MBT option is still the most favourable when varying these criteria, it does however show that the order may change with respect to the EfW and ATT options, and that they are equally favourable when compared to each other, from the stand point of the EOA evaluation

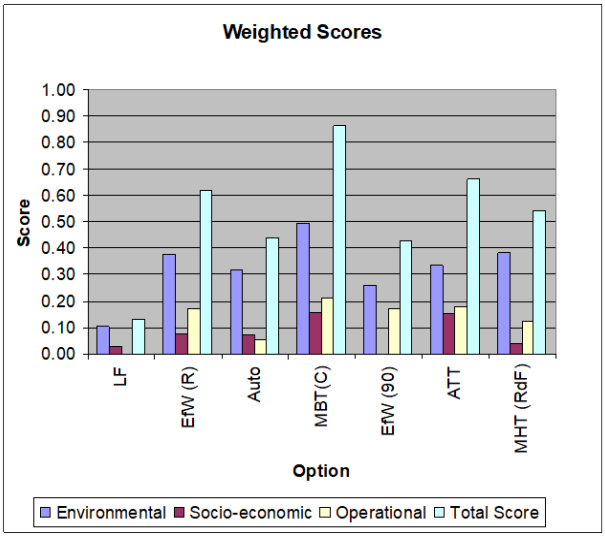
Chart F.1: Graph of results for the sensitivity analysis




## F.1.6. Conclusions

This outcome is different to the modelling previously conducted for the BEO assessment, which showed ATT as the preferred option.

Chart F.2: Final weighted scores




However, the assessment is based upon;

- the WRATE modelling, which has superseded the WISARD modelling used in the previous study
- the updated costs modelling
- greater use of empirical data through the use of the more sophisticated WRATE model and data

Also, we have a much better understanding of the deliverability and bankability of the options. However, the bulk of the scores in MBT's favour were environmental as well as the socio-economic and more subjective factors. So we can have some confidence that the outcome would be the same even taking these into account.

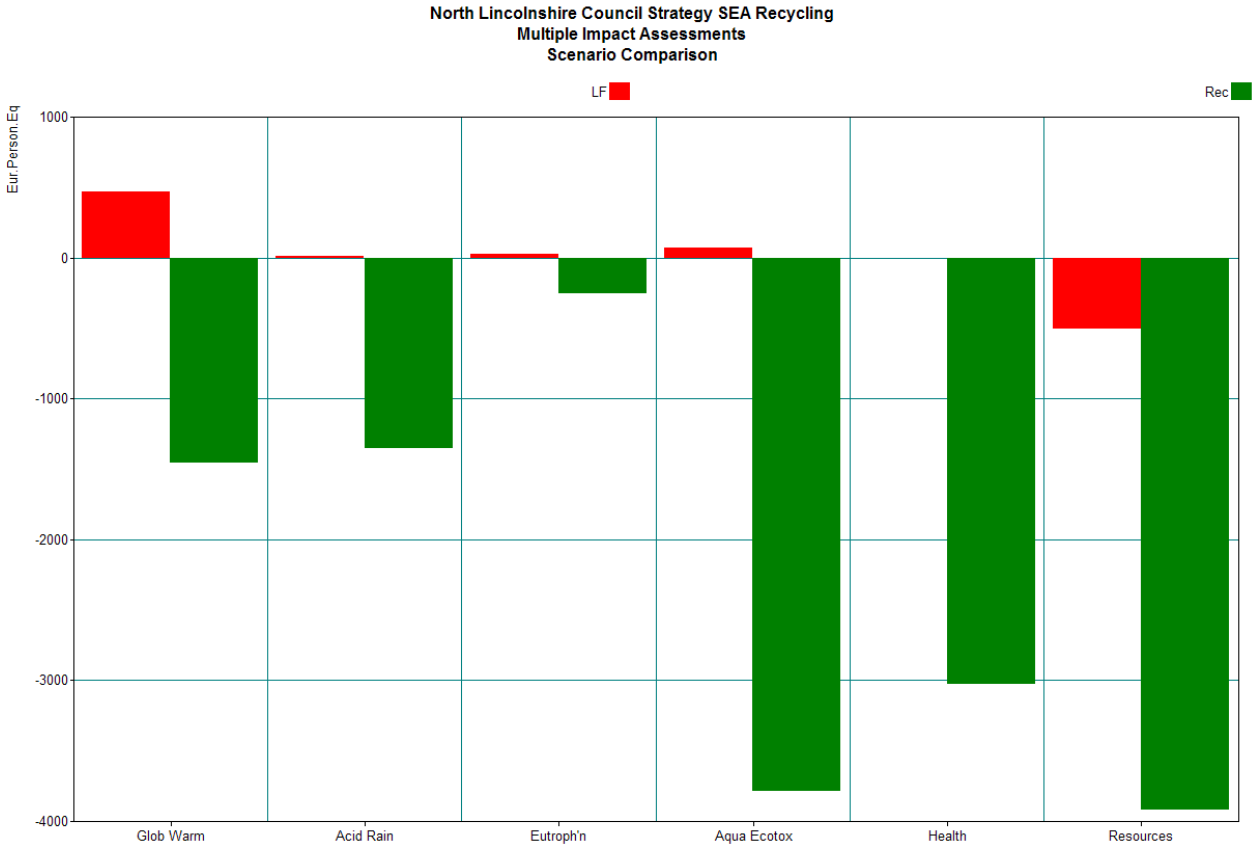
## F.2. WRATE analysis

WRATE analysis has been done for the three types of service that the Council provides i.e. the Recycling, Residual and Organics services.

### F.2.1. Recycling Analysis

The recycling service WRATE analysis is based upon the recycling figures reported via wastedataflow. For the year 2010/2011 and supplied by the Council. The composition breakdown is based upon these figures together with the overall tonnages to give the dataset contained within the WRATE report pdf file that accompanies this document.

Chart F.3: Recycling service results




The first set of results is for the recycling service. This is illustrative to show the benefits of recycling, and provides data for the assessment of the whole service below.

The results are shown in the tables below in normalised (per person) and 'characterised' - using physical units

Table F.4: Normalised results

| | Impact Assessment | Unit | LF | Rec |
|---|---|---|---|---|
| 1 | climate change: GWP 100a | Eur.Person.Eq | 483 | -1,495 |
| 2 | acidification potential: average European | Eur.Person.Eq | 15 | -1,390 |
| 3 | eutrophication potential: generic | Eur.Person.Eq | 31 | -260 |
| 4 | freshwater aquatic ecotoxicity: FAETP infinite | Eur.Person.Eq | 71 | -3,902 |
| 5 | human toxicity: HTP infinite | Eur.Person.Eq | 0 | -3,125 |
| 6 | resources: depletion of abiotic resources | Eur.Person.Eq | -519 | -4,021 |

Table F.5: Characterised results

| | Impact Assessment | Unit | LF | Rec |
|---|---|---|---|---|
| 1 | climate change: GWP 100a | kg CO2-Eq | 6,245,847 | -19,320,022 |
| 2 | acidification potential: average European | kg SO2-Eq | 1,057 | -99,446 |
| 3 | eutrophication potential: generic | kg PO4-Eq | 1,029 | -8,697 |
| 4 | freshwater aquatic ecotoxicity: FAETP infinite | kg 1,4-DCB-Eq | 92,960 | -5,145,484 |
| 5 | human toxicity: HTP infinite | kg 1,4-DCB-Eq | 8,461 | -61,757,307 |
| 6 | resources: depletion of abiotic resources | kg antimony-Eq | -20,038 | -155,385 |

## F.3. Residual waste treatment comparison

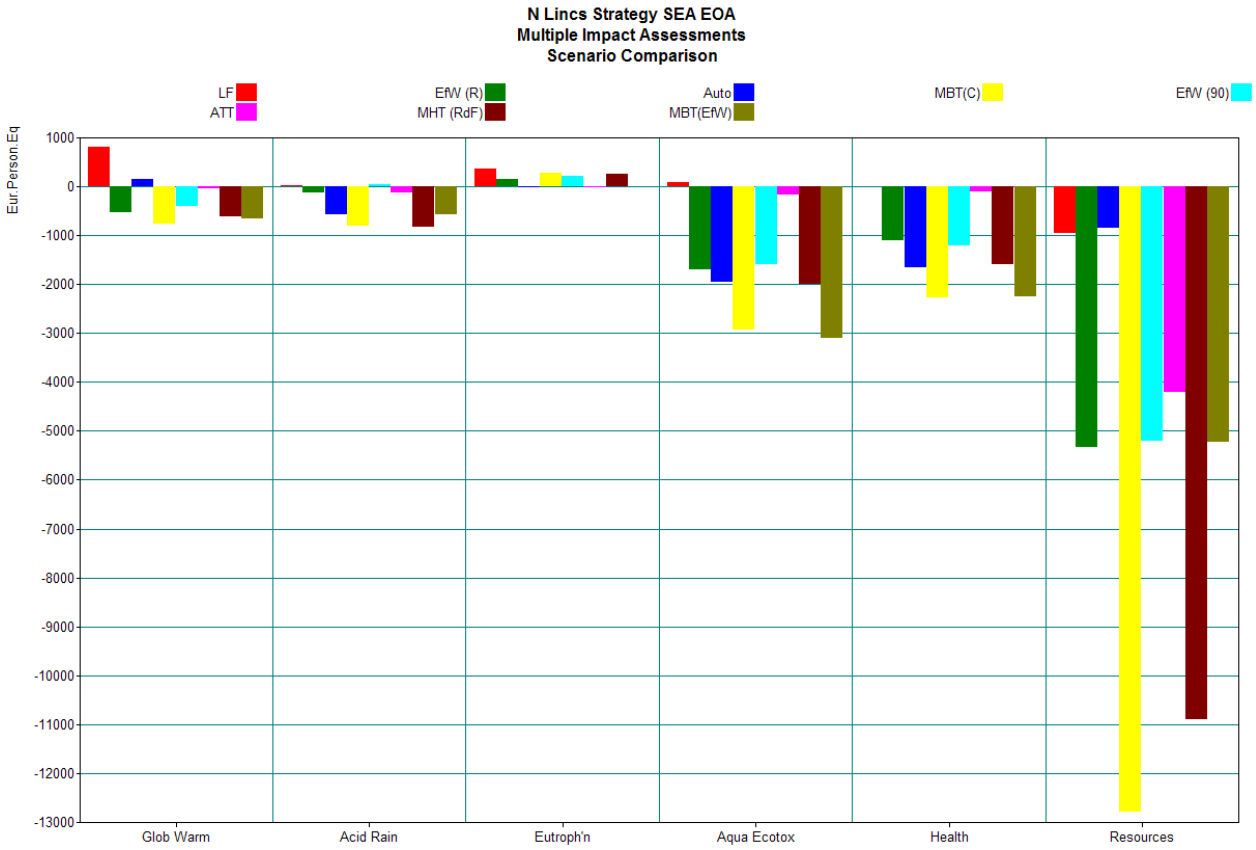
A similar exercise has been done for the residual scenarios discussed above in the BEO assessment above. In addition to the 7 options assessed in the BEO assessment, the option of MBT plus EfW has been assessed on request by the Council to establish the benefits or otherwise of this option compared to the BEO MBT followed by SRF combustion in a cement kiln.

### F.3.1.1. Data

The data used to build up the model consist of the results of the mass flow modelling undertaken to underpin all of the studies which provided the tonnages, together with the composition studies mentioned in section 3 of the main document which have provided the composition data. The .pdf 'project report' for the study accompanies this document, and shows all of the data and assumptions used.

The overall comparison shows the scores for each of the six criteria that WRATE assesses, together with some of these extracted and shown separately below.

Chart F.4: Graph of combined results for residual waste




The data shows that overall in terms of Global warming potential and resource depletion that MBT(C) is the best scoring option of those considered in the studies, including MBT (EfW).

Again the data is presented below in normalised and characterised forms.

Table F.6: Normalised results

| | Impact Assessment | Unit | LF | EfW (R) | Auto | MBT(C) | EfW (90) | ATT | MHT (RdF) | MBT(EfW) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | climate change: GWP 100a | Eur.Person.Eq | 787 | -517 | 137 | -730 | -390 | -41 | -596 | -642 |
| 2 | acidification potential: average European | Eur.Person.Eq | 22 | -129 | -558 | -775 | 33 | -119 | -802 | -547 |
| 3 | eutrophication potential: generic | Eur.Person.Eq | 350 | 145 | -12 | 276 | 213 | -11 | 250 | -4 |
| 4 | freshwater aquatic ecotoxicity: FAETP infinite | Eur.Person.Eq | 93 | -1,625 | -1,885 | -2,830 | -1,535 | -152 | -1,928 | -2,989 |
| 5 | human toxicity: HTP infinite | Eur.Person.Eq | -3 | -1,069 | -1,603 | -2,192 | -1,168 | -94 | -1,541 | -2,158 |
| 6 | resources: depletion of abiotic resources | Eur.Person.Eq | -922 | -5,128 | -810 | -12,319 | -5,019 | -4,049 | -10,502 | -5,035 |

Table F.7: Characterised results

| | Impact Assessment | Unit | LF | EfW (R) | Auto | MBT(C) | EfW (90) | ATT | MHT (RdF) | MBT(EfW) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | climate change: GWP 100a | kg CO2-Eq | 10,173,526 | -6,680,227 | 1,770,512 | -9,430,200 | -5,039,699 | -528,234 | -7,702,564 | -8,296,975 |
| 2 | acidification potential: average European | kg SO2-Eq | 1,595 | -9,261 | -39,924 | -55,435 | 2,343 | -8,482 | -57,340 | -39,127 |
| 3 | eutrophication potential: generic | kg PO4-Eq | 11,703 | 4,853 | -396 | 9,217 | 7,132 | -350 | 8,362 | -130 |
| 4 | freshwater aquatic ecotoxicity: FAETP infinite | kg 1,4-DCB-Eq | 122,537 | -2,143,000 | -2,486,018 | -3,732,068 | -2,023,397 | -200,433 | -2,542,295 | -3,940,838 |
| 5 | human toxicity: HTP infinite | kg 1,4-DCB-Eq | -50,095 | -21,131,700 | -31,674,425 | -43,319,657 | -23,078,283 | -1,851,673 | -30,463,094 | -42,645,125 |
| 6 | resources: depletion of abiotic resources | kg antimony-Eq | -35,640 | -198,140 | -31,308 | -476,028 | -193,958 | -156,476 | -405,835 | -194,567 |

### F.3.2. Energy Recovery Comparison

The energy recovery from the scenarios is shown in the chart and table below.

Chart F.5: Comparative energy recovery by treatment technology

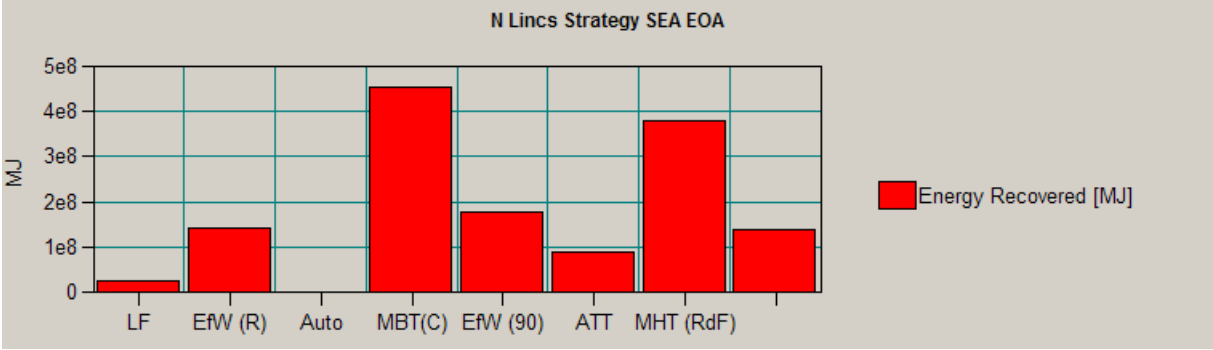



Table F.8: Table of energy recovery comparison

| Project Headline Indicators | LF | EfW (R) | Auto | MBT(C) | EfW (90) | ATT | MHT (RdF) | MBT(EfW) |
|---|---|---|---|---|---|---|---|---|
| Energy Recovered [MJ] | 23,811,621 | 1.38E+08 | 324754 | 4.36E+08 | 1.7E+08 | 85,104,245 | 3.67E+08 | 1.32E+08 |

### F.3.3. Conclusion

From this assessment MBT(C) scores more highly than the other options which generate electricity, including MBT (EfW). This is because of the efficiency of the boiler which in CHP, even with district heating this rarely rises above 60%, whereas the fuel used in the cement kiln option is used directly. However in a comparison of electricity generated MBT (C) would have a zero score compared with the electricity generating options.

### F.3.4. Global Warming Potential

The chart and tables for GWP (100) are shown below.

Chart F.6: Comparison of global warming potential by treatment technology

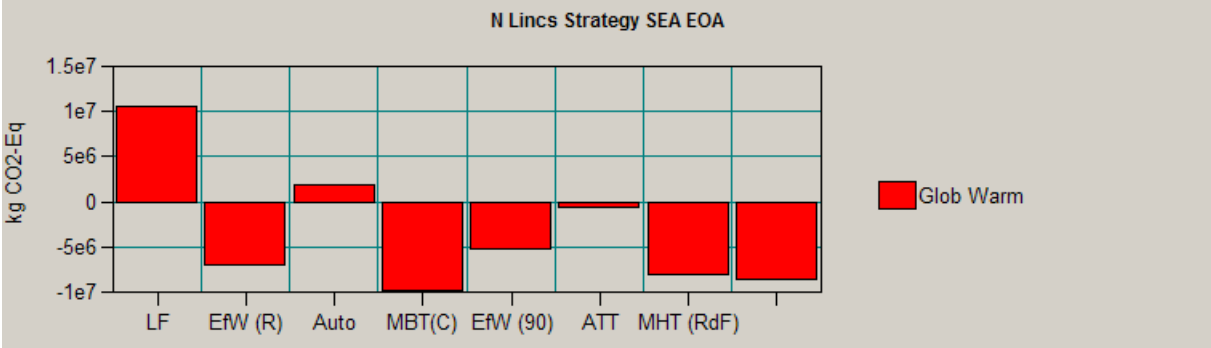



Table F.9: Table of results for global warming potential

| Impact Assessments | Unit | LF | EfW (R) | Auto | MBT(C) | EfW (90) | ATT | MHT (RdF) | MBT(EfW) |
|---|---|---|---|---|---|---|---|---|---|
| climate change: GWP 100a | kg CO2-Eq | 10,565,295 | 10,173,526 | -6,680,227 | 1,770,512 | -9,430,200 | -50,396,99 | -528,234 | -7,702,564 |

## F.3.5. Resource Depletion

The chart and tables for resource depletion are shown below.

Chart F.7: Comparison of resource depletion by treatment technology

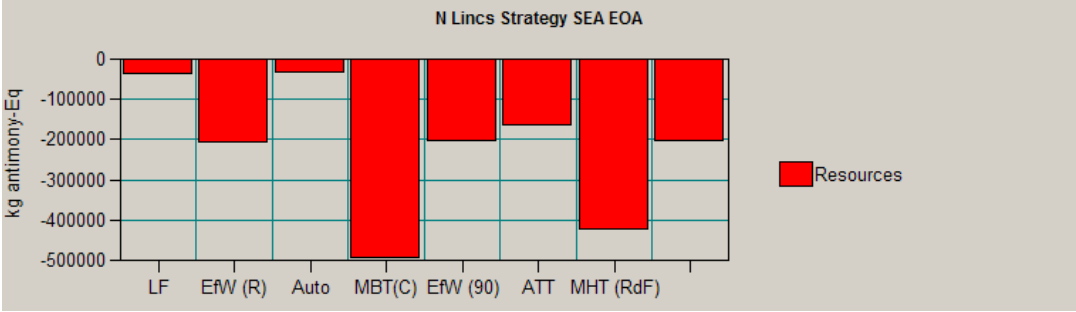



Table F.10: Table of results for resource depletion

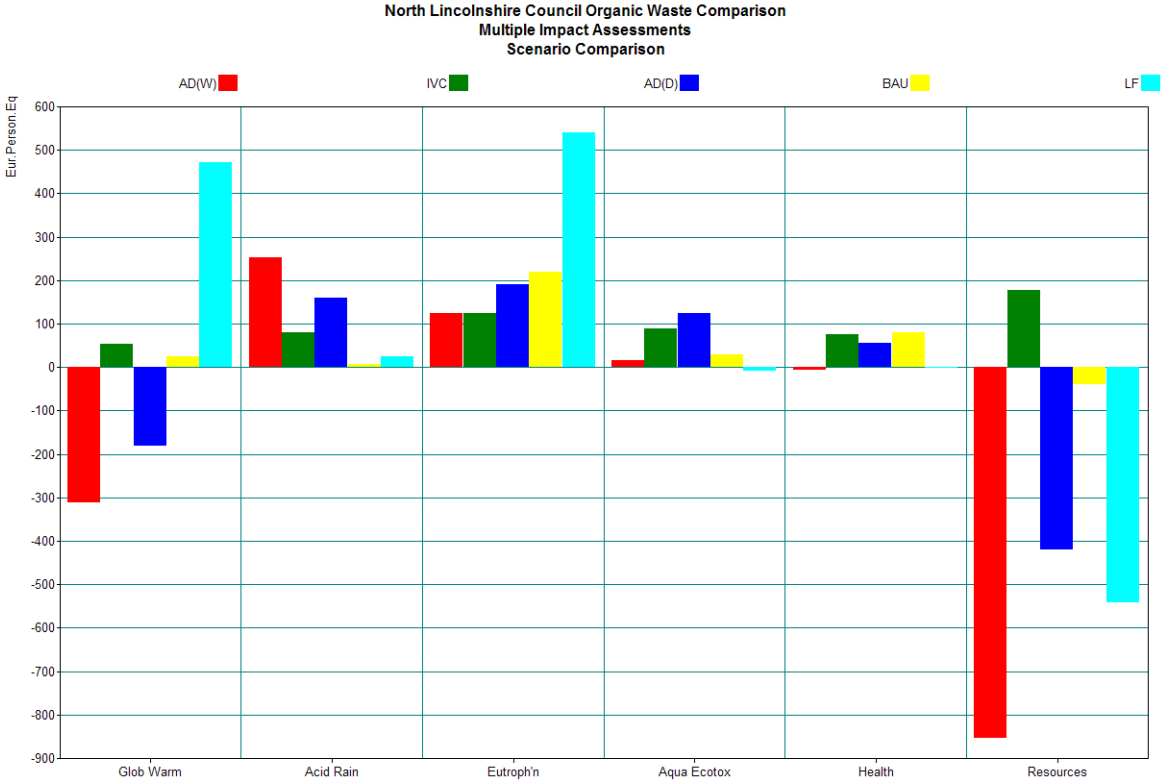
| Impact Assessments | Unit | LF | EfW (R) | Auto | MBT(C) | EfW (90) | ATT | MHT (RdF) | MBT(EfW) |
|---|---|---|---|---|---|---|---|---|---|
| resources: depletion of abiotic resources | kg antimony-Eq | -35640 | -198140 | -31308 | -476028 | -193958 | -156476 | -405835 | -194567 |

## F.3.6. Conclusions

The greater efficiency of the MBT(C) option in converting waste to product shows up as a higher score in the WRATE analysis, for both GWP (100) and resource depletion.

## F.4. Organic waste treatment comparison

Chart F.8: Comparison of multiple impacts by treatment technology




A WRATE study has also been conducted of the options for treating organic wastes

These are:

- business as usual (BAU) (i.e. windrow of green with food in residual)
- Wet anaerobic digestion
- Dry anaerobic digestion
- In-Vessel Composting

These are compared with the 'do-nothing' option of landfilling all of the green waste. This is illustrative to show the benefits the technical options and will be used within the strategy document itself to show how the system of organic waste management has improved over time, and the further benefits that can be gained.

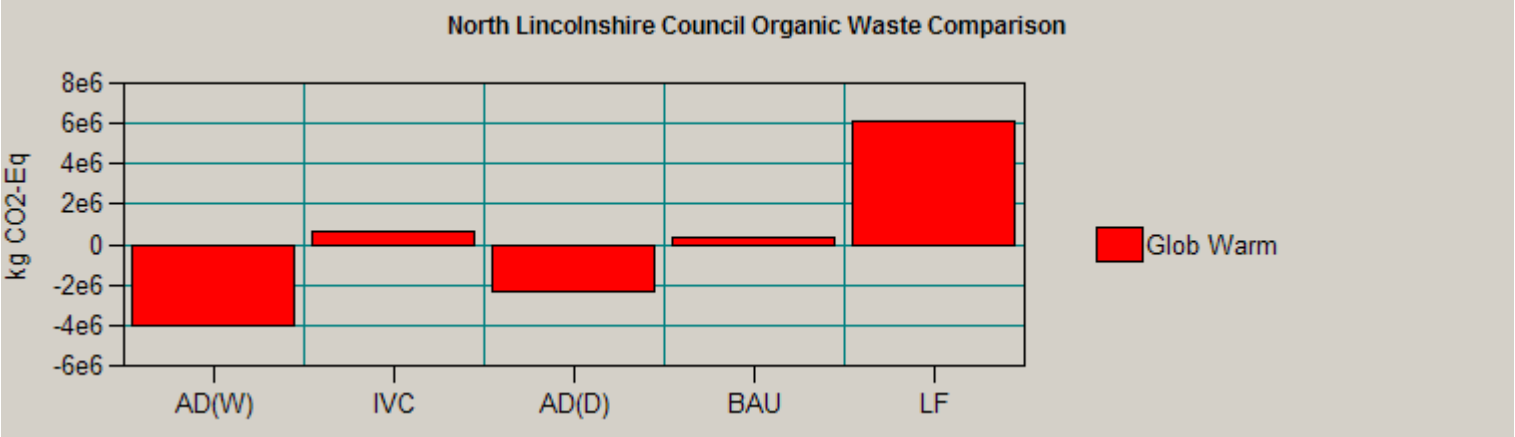
Table F.11: Normalised results

| | Impact Assessment | Unit | AD(W) | IVC | AD(D) | BAU | LF |
|---|---|---|---|---|---|---|---|
| 1 | climate change: GWP 100a | Eur.Person.Eq | -312 | 52.9 | -181 | 23.8 | 472 |
| 2 | acidification potential: average European | Eur.Person.Eq | 254 | 79.4 | 159 | 7.42 | 24.6 |
| 3 | eutrophication potential: generic | Eur.Person.Eq | 123 | 124 | 191 | 219 | 540 |
| 4 | freshwater aquatic ecotoxicity: FAETP infinite | Eur.Person.Eq | 15.5 | 89.8 | 124 | 29.4 | -8.75 |
| 5 | human toxicity: HTP infinite | Eur.Person.Eq | -7.01 | 76.3 | 55.4 | 80.1 | -1.99 |
| 6 | resources: depletion of abiotic resources | Eur.Person.Eq | -853 | 177 | -420 | -38.3 | -541 |

Table F.12: Characterised results

| | Impact Assessment | Unit | AD(W) | IVC | AD(D) | BAU | LF |
|---|---|---|---|---|---|---|---|
| 1 | climate change: GWP 100a | kg CO2-Eq | -4035849 | 683486 | -2336971 | 307938 | 6105850 |
| 2 | acidification potential: average European | kg SO2-Eq | 18149 | 5680 | 11373 | 531 | 1757 |
| 3 | eutrophication potential: generic | kg PO4-Eq | 4124 | 4138 | 6375 | 7312 | 18031 |
| 4 | freshwater aquatic ecotoxicity: FAETP infinite | kg 1,4-DCB-Eq | 20476 | 118379 | 163401 | 38804 | -11539 |
| 5 | human toxicity: HTP infinite | kg 1,4-DCB-Eq | -138472 | 1508796 | 1094801 | 1582921 | -39348 |
| 6 | resources: depletion of abiotic resources | kg antimony-Eq | -32954 | 6831 | -16249 | -1481 | -20895 |

H.4.2. Global Warming Comparison for Organics




The GWP (100) data has been extracted for greater clarity.

Table F.13: Table for organics global warming comparison

| Impact Assessments | Unit | AD(W) | IVC | AD(D) | BAU | LF |
|---|---|---|---|---|---|---|
| climate change: GWP 100a | kg CO2-Eq | -4035849 | 683486 | -2336971 | 307938 | 6105850 |

F.4.1. Conclusions

The data shows that the current service is a considerable improvement over ‘do nothing’. IVC would result in a slightly higher global warming impact compared with business as usual (BAU). Most desirable would be either of the two AD options. The possibility of generating electricity therefore adds considerably to the overall performance of the system.

## F.5. Whole service impacts

The whole service impacts have been calculated on the ‘business as usual’ basis and also for the ‘wet AD’ scenario together with the calculated impact of the recycling service together with the various residual options.

Table F.14: Business as Usual (BAU) organics

| | Impact Assessment | Unit | LF | EfW (R) | Auto | MBT(C) | EfW (90) | ATT | MHT (RdF) | MBT(EfW) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | climate change: GWP 100a | kg CO2-Eq | -8838558 | -2.6E+07 | -1.7E+07 | -2.8E+07 | -2.4E+07 | -2E+07 | -2.7E+07 | -2.7E+07 |
| 2 | acidification potential: average European | kg SO2-Eq | -97320 | -108176 | -138839 | -154350 | -96572 | -107397 | -156255 | -138042 |
| 3 | eutrophication potential: generic | kg PO4-Eq | 10318 | 3468 | -1781 | 7832 | 5747 | -1735 | 6977 | -1515 |
| 4 | freshwater aquatic ecotoxicity: FAETP infinite | kg 1,4-DCB-Eq | -4984143 | -7249680 | -7592698 | -8838748 | -7130077 | -5307113 | -7648975 | -9047518 |
| 5 | human toxicity: HTP infinite | kg 1,4-DCB-Eq | -60224481 | -8.1E+07 | -9.2E+07 | -1E+08 | -8.3E+07 | -6.2E+07 | -9.1E+07 | -1E+08 |
| 6 | resources: depletion of abiotic resources | kg antimony-Eq | -8838558 | -2.6E+07 | -1.7E+07 | -2.8E+07 | -2.4E+07 | -2E+07 | -2.7E+07 | -2.7E+07 |

Table F.15: Whole service and wet AD

| | Impact Assessment | Unit | LF | EfW (R) | Auto | MBT(C) | EfW (90) | ATT | MHT (RdF) | MBT(EfW) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | climate change: GWP 100a | kg CO2-Eq | -13182345 | -3E+07 | -2.2E+07 | -3.3E+07 | -2.8E+07 | -2.4E+07 | -3.1E+07 | -3.2E+07 |
| 2 | acidification potential: average European | kg SO2-Eq | -79702 | -90558 | -121221 | -136732 | -78954 | -89779 | -138637 | -120424 |
| 3 | eutrophication potential: generic | kg PO4-Eq | 7130 | 280 | -4969 | 4644 | 2559 | -4923 | 3789 | -4703 |
| 4 | freshwater aquatic ecotoxicity: FAETP infinite | kg 1,4-DCB-Eq | -5002471 | -7268008 | -7611026 | -8857076 | -7148405 | -5325441 | -7667303 | -9065846 |
| 5 | human toxicity: HTP infinite | kg 1,4-DCB-Eq | -61945874 | -8.3E+07 | -9.4E+07 | -1.1E+08 | -8.5E+07 | -6.4E+07 | -9.2E+07 | -1E+08 |
| 6 | resources: depletion of abiotic resources | kg antimony-Eq | -13182345 | -3E+07 | -2.2E+07 | -3.3E+07 | -2.8E+07 | -2.4E+07 | -3.1E+07 | -3.2E+07 |

This data is illustrative and will give an indication of the potential of the fully rolled out ‘best environmental option’. This data could form the basis of bench-marking for any future service, possibly.

## F.6. Costs analysis

### F.6.1. Gate fees

A cost model has been built up based upon an analysis of the mass flows and the costs per tonne for the three main services. The costs for the landfill of residual waste and the costs per tonne of the recycling service were provided by the Council. The gate fees used for the various technical options are shown below. These are based upon our knowledge of the local market. Market intelligence and a survey of gate fees nationally conducted by WRAP.

Table F.16: Table of gate fees used

| | Gate fees/ tonne | Transport distance | Cost/tonne/ mile (round trip) | Total cost for treatment/ tonne |
|---|---|---|---|---|
| Landfill (exc tax) | £12 | 0.0 | 0.28 | £12 |
| EfW (regional) | £97 | 29.4 | 0.28 | £105 |
| EfW (90) | £97 | 90.0 | 0.28 | £122 |
| Autoclave | £90 | 46.4 | 0.28 | £103 |
| ATT | £102 | 0.0 | 0.28 | £102 |
| MBT | £100 | 0.0 | 0.28 | £100 |
| MHT (RDF) | £105 | 46.9 | 0.28 | £118 |
| Green treatment | £26 | 0.0 | 0.28 | £26 |
| Food AD | £45 | 0.0 | 0.28 | £45 |
| Recycling | £44 | 0.0 | 0.28 | £44 |

### F.6.2. Cost of technologies without food collection

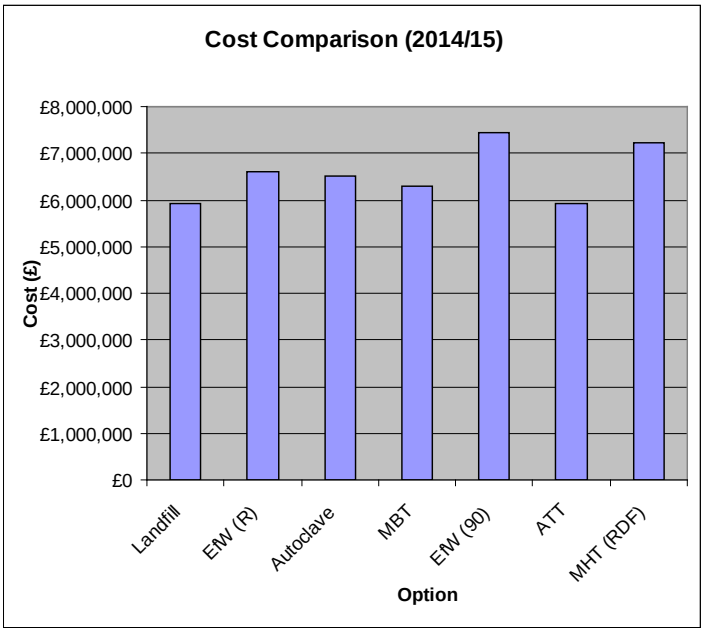
The results of the analysis for the service with no changes to the management of organic wastes are:

Table F.17: Total waste management costs for 'BAU' option

| Scenario | 2014/15 | 2019/20 | 2029/30 |
|---|---|---|---|
| Landfill | £5,918,938 | £6,048,914 | £6,328,673 |
| Landfill (High) | £5,918,938 | £7,975,183 | £8,344,032 |
| EfW (R) | £6,590,520 | £6,831,773 | £7,420,108 |
| Autoclave | £6,512,974 | £6,808,387 | £7,553,267 |
| MBT | £6,295,913 | £6,434,168 | £6,731,745 |
| EfW (90) | £7,453,190 | £7,904,390 | £9,081,275 |
| ATT | £5,918,938 | £6,530,481 | £6,832,513 |
| MHT (RDF) | £7,227,224 | £7,539,965 | £8,323,316 |

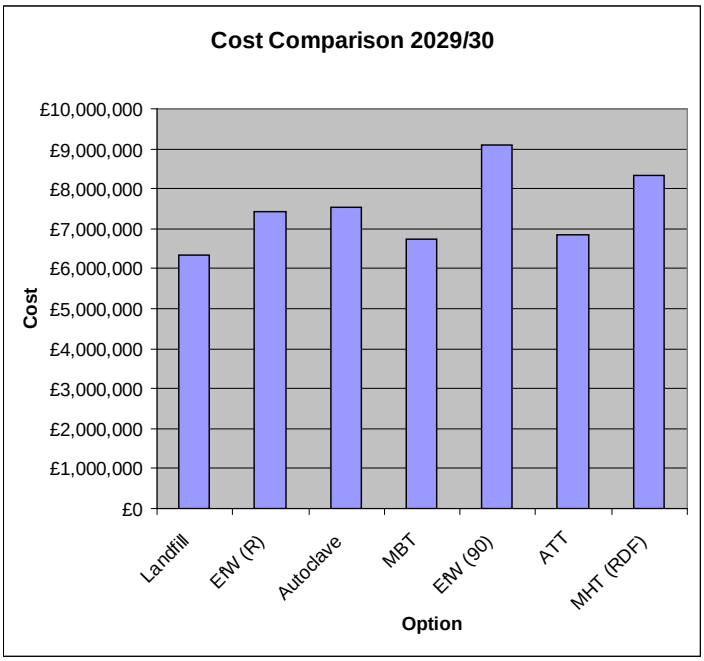
The cost comparison at the beginning of the strategy reflects the different timescales over which a facility can be delivered. Post abandonment of LATS this results in a cost saving in the early years of the contract as there is no penalty for missing LATS targets.

Chart F.9: Cost comparison by treatment technology in 2014/15



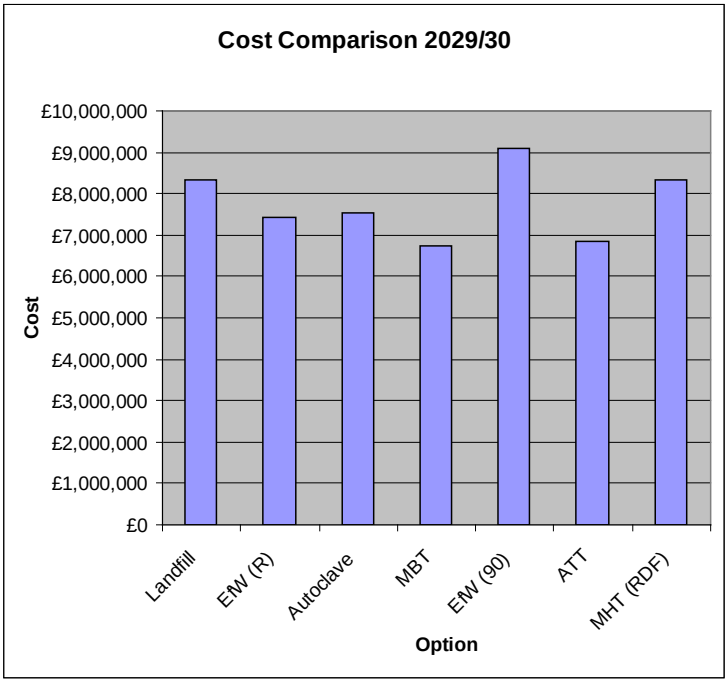

The costs profile at 2029/30 is basically the same after the 6th year of the study, due to the delivery of plants such as the ATT. This also has the effect of slightly lowering the whole project cost for this option artificially.

Chart F.10: Cost comparison by treatment technology in 2029/30



This graph in comparison with the previous graph shows the effect of the increased landfill tax rate scenario.

Chart F.11: Cost comparison by treatment technology in 2029/30 – High tax case




## F.6.3. Cost of technologies with food collection

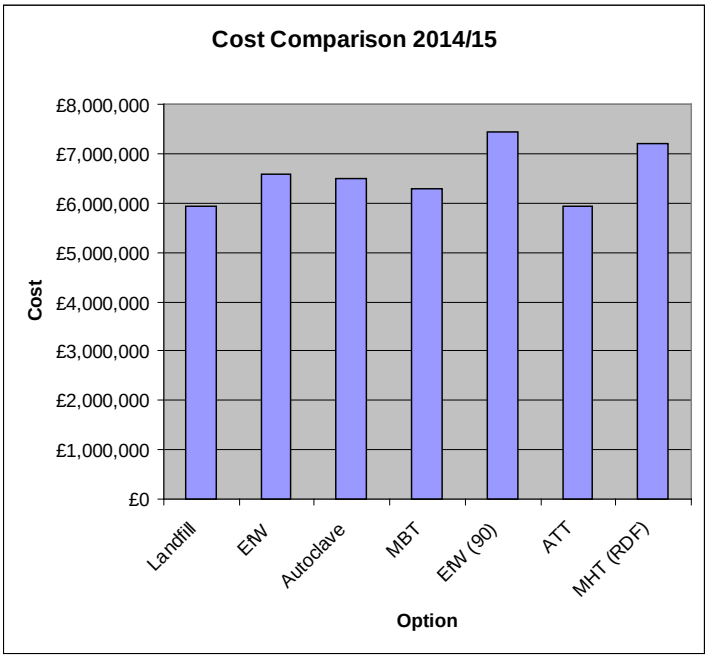
The costs of introducing food waste collection have been integrated into the model for comparison purposes, and are based upon studies done by the Council on the feasibility of introducing weekly commingled food and green waste collection.

Table F.18: Overall costs of technology options with food collection (£ million)

| Scenario | 2014/15 | 2019/20 | 2029/30 |
|---|---|---|---|
| Landfill | £5,918,938 | £6,564,191 | £6,828,630 |
| Landfill (High) | £5,918,938 | £8,209,846 | £8,550,336 |
| EfW (R) | £6,575,233 | £7,212,423 | £7,739,424 |
| Autoclave | £6,497,924 | £7,192,536 | £7,852,679 |
| MBT | £6,281,526 | £6,874,310 | £7,153,959 |
| EfW (90) | £7,435,268 | £8,124,549 | £9,152,279 |
| ATT | £5,918,938 | £6,956,212 | £7,239,664 |
| MHT (RDF) | £7,209,993 | £7,814,651 | £8,507,620 |

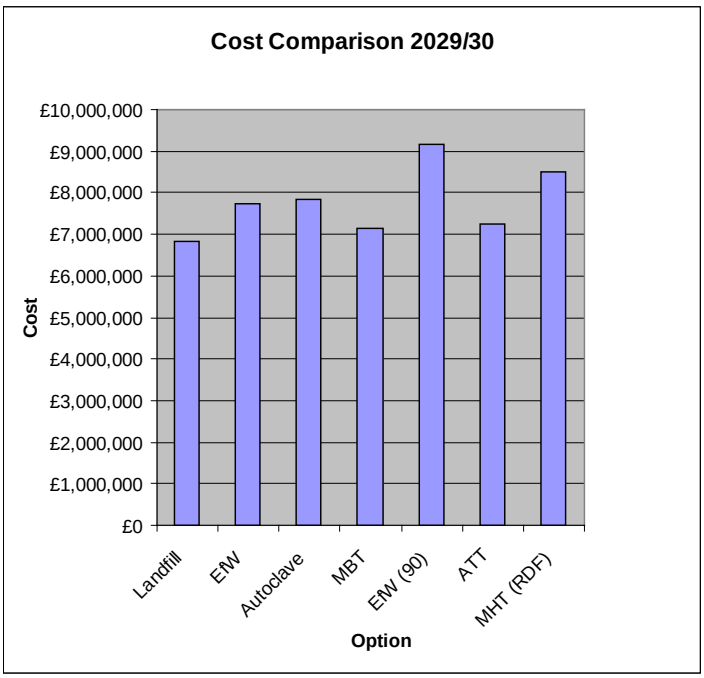
As above, cost comparison at the beginning of the strategy reflects the different timescales over which a facility can be delivered. Post abandonment of LATS, this results in a cost saving in the early years of the contract as there is no penalty for missing LATS targets.

Chart F.12: Graph of costs 2014/2015



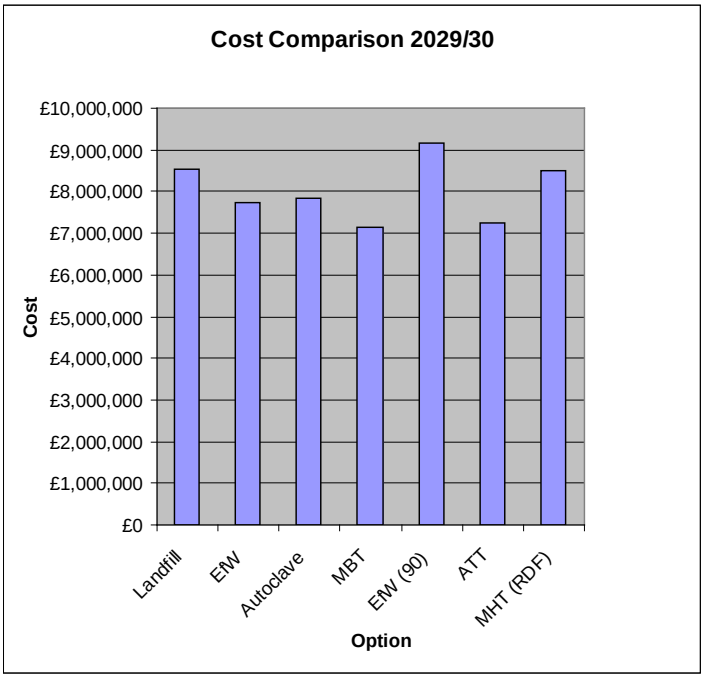

Similarly, the costs profile at 2029/30 is basically the same after the 6th year of the study, due to the delivery of plants such as the ATT. This also has the effect of slightly lowering the whole project cost for this option artificially.

Chart F.13: Graph of costs 2029/30




This graph in comparison with the previous graph shows the effect of the increased landfill tax rate scenario.

Chart F.14: Graph of costs 2029/30 – High tax case




### F.6.4. Conclusions

From the study it can be concluded that MBT(C) is competitive on price. It cannot be said the outcome of this study will always be the same as the gate fees for the ATT, EfW and MHT options are based on MI and literature only and therefore can show a considerable variation either way, as these fees are usually project specific.

### F.6.5. Headline tables for the service with and without food collection

Some headline figures have been calculated for the whole service over the lifespan of the project, together with an assessment of the additional costs of MBT (EfW) compared to MBT (C).

Table F.19: Without food collection

| Low Tax Without Food | Total | Cost per household | Cost per capita |
|---|---|---|---|
| Landfill (Current) | £6,328,673 | £87.46 | £36.31 |
| Landfill (High) | £8,344,032 | £115.31 | £47.87 |
| EfW (R) | £7,420,108 | £102.55 | £42.57 |
| Autoclave | £7,553,267 | £104.39 | £43.33 |
| MBT | £6,731,745 | £93.03 | £38.62 |
| EfW (90) | £9,081,275 | £125.50 | £52.10 |
| ATT | £6,832,513 | £94.43 | £39.20 |
| MHT (RDF) | £8,323,316 | £115.03 | £47.75 |

Table F.20: With food collection

| Low Tax With Food | Total | Cost per household | Cost per capita |
|---|---|---|---|
| Landfill (Current) | £6,828,630 | £94.37 | £39.17 |
| Landfill (High) | £8,550,336 | £118.17 | £49.05 |
| EfW (R) | £7,739,424 | £106.96 | £44.40 |
| Autoclave | £7,852,679 | £108.52 | £45.05 |
| MBT | £7,153,959 | £98.87 | £41.04 |
| EfW (90) | £9,152,279 | £126.48 | £52.50 |
| ATT | £7,239,664 | £100.05 | £41.53 |
| MHT (RDF) | £8,507,620 | £117.58 | £48.80 |

### F.6.6. Comparison of Costs of MBT with and without EfW

As apart of the study looking at the merits of MBT with and without EfW as opposed to cement kiln SRF the additional impact of the EfW gate fee has been calculated.

Table F.21: Comparison of costs

| Gate fee | Cost |
|---|---|
| £100 | £6,295,913 |
| £110 | £6,767,133 |
| £120 | £7,238,353 |
| £130 | £7,709,572 |

### F.6.7. Conclusion

There is an increased cost of £471,220 per annum or approximately another £9.5 M over the lifespan of the strategy, for every £10 per tonne additional gate fee incurred above the figure used in the study. This was based upon the current procurement project where the off-take gate is considered to be below the current general market rate, so the outcome of a repeat of the current procurement project would in all likelihood be a similar project technically, but with significantly higher overall costs.

## F.7. Overall conclusions

### F.7.1. Technical

- The BEO assessment shows that the MBT (cement kiln) option scores highest compared with other options overall. The environmental studies, together with the deliverability of the technology are key strengths compared with the other options.
- The WRATE analysis also shows that the MBT (C) option has the highest overall score in key areas such as Global Warming Potential (GWP), Resource Depletion and in Energy preproduction (note; energy as opposed to electricity.
- For the overall service including organic treatment and recycling collection, the overall performance of the system could be enhanced by the use of anaerobic digestion for the treatment of organic wastes.
  - The down-side of this is that the previous procurement project showed that AD options offered were prohibitively expensive. The feasibility study conducted into the option of a regional facility including 3rd party wastes was marginal in terms of feasibility

  - The overall small quantity of food waste is the main reason why the costs of AD were previously prohibitive, as this is only 6,000 – 8,000 tonnes approximately, which lower than the smallest scale of plant generally considered to be economic at around 12,500 tonnes (it should be noted that this is in the Welsh market mainly, where funding form the Welsh government is available).
  - There would be a need to inject a further impetus into the funding of such an option through the use for prudential borrowing potentially. However one of the key factors in making a plant 'bankable' is security of supply, and this would be difficult to guarantee without food waste from other authorities, or another similar source.
  - Taking food waste from the wastes going to the MBT currently under procurement may result in financial penalties to the Council, if this were to be contracted, resulting in the Council having less flexibility in delivering the 'best option' for the overall service.
- In terms of deliverability, the option of IVC for the Council's organic wastes is the more deliverable option for several reasons;
  - The Council's waste stream is directly applicable to the technology as the higher proportion of green waste compared to food waste is suitable for this technology.
    - For anaerobic digestion the presence of a high proportion of green waste is nor desirable, plants under procurement tend to be 'food waste only' or 'food waste plus energy crops' – if a source of energy crops could be guaranteed this would possibly make AD viable with the Council's waste streams
- In terms of environmental performance IVC offers improvement over the current system, together with a product (PAS100 compost) which has an established market.

### F.7.2. Costs

- The costs study shows that the MBT© option is competitive on overall costs. As noted previously there is much more certainty over the gate fee for this option than there are for the others, as these are notional based upon literature and MI values which are not project specific. The overall costs may therefore be more competitive than indicated in the study, particularly for ATT where there is some degree of uncertainty.
- The study does not include the costs of procurement.
  - This could be considerable, particularly if this has to be repeated as in the case of the organics, where the preferred option may not be economically viable, even with 3rd party involvement or prudential borrowing.
  - If the residual contract were to re-procured there is no guarantee that the same gate fees would be offered.
  - There would also be the risk of market failure for certain technologies such as ATT
  - This would tend to suggest that a repeat of the residual procurement should be technology specific and using the restricted procedure rather than competitive dialogue, as the specific of the technology are sufficiently well known now to enable this route to be followed.
- For organics, IVC is generally considered to have a lower gate fee than for an equivalent AD plant, and is more likely to achieve the desired 'break-even gate fee of £43 per tonne to allow food waste to be collected. Even with IVC this would be difficult, due to the relatively small overall tonnage of material offered by the Council.

# Appendix G. Sources of Further Information

This Appendix lists a number of Internet sites that provide further information.

## G.1. Policy makers

EU Environment Directorate – European environment policy
http://europa.eu.int/comm/environment/index_en.htm

Department for Environment, Food and Rural Affairs (Defra) – UK environment policy
http://www.defra.gov.uk/environment/waste/index.htm

Defra - Local authority support http://lasupport.defra.gov.uk/

Department for Communities and Local Government – Responsibilities for planning
http://www.communities.gov.uk

Regulators

Environment Agency http://www.environment-agency.gov.uk

State Veterinary Service (has responsibilities regarding composting of food waste)
http://www.svs.gov.uk

Waste minimisation and awareness

National Resource and Waste Forum - Promotes sustainable resource and waste management.
http://www.nrwf.org.uk

Recycle Now Campaign http://www.recyclenow.com

Mailing preference service - Reducing the amount of direct/junk mail received
http://www.mpsonline.org.uk

Women's Environmental Network http://www.wen.org.uk

Real Nappy Campaign http://www.realnappycampaign.com/index.html

Wastewatch http://www.wastewatch.org.uk

## G.2. Re-use

Community Recycling Network – the national umbrella organisation for community-based, not-for-profit and co-operative waste management groups which work in reduction, re-use and recycling.
http://www.crn.org.uk

Remploy – Refurbishment of white goods http://www.remploy.co.uk

CREATE UK – Refurbishment of white goods http://www.createuk.com

## G.3. Recycling

A list of recycling locations and facilities in North Lincolnshire is available at: http://www.northlincs.gov.uk/NorthLincs/Environment/recycling/CommunityRecycling Facilities.htm

Waste and Resources Action Programme (WRAP) http://www.wrap.org.uk

Paper – Confederation of Paper Industries http://www.paper.org.uk

Glass - British Glass http://www.britglass.org.uk/index.html

Plastic – British Plastics Federation http://www.bpf.co.uk

Steel – Steel Can Recycling Information Bureau (SCRIB) http://www.scrib.org

Aluminium – Aluminium Packaging Recycling Association (Alupro) http://www.alupro.org.uk

Textiles - Salvation Army http://www.satradingco.org

Packaging – Industry Council for Packaging and the Environment (INCPEN) http://www.incpen.org

## G.4. Composting

Composting Association http://www.compost.org.

Community Composting Network http://www.communitycompost.org

Treatment of residual waste

Defra – waste implementation programme http://www.defra.gov.uk/environment/waste/wip/index.htm

Waste Technology Data Centre http://www.environment-agency.gov.uk/wtd

Report - Mechanical biological treatment: a guide for decision makers http://www.juniper.co.uk

Waste management companies currently used by North Lincolnshire

SITA North Lincolnshire Limited – operate the Household Recycling Centres, the Lower Trent Composting Plant and the landfill site currently used to dispose of municipal solid wastes produced in North Lincolnshire http://www.sita.co.uk

Abitibi Bowater Recycling Europe – operate the kerbside box recycling collection scheme and service the 'bring' recycling facilities located throughout North Lincolnshire http://www.abitibiconsolidated.co.uk

Other sources of information

4Ps – Provide procurement Support to Local Authorities http://www.4ps.co.uk

Letsrecycle – Articles on recycling http://www.letsrecycle.com

Local Authority Recycling Advisory Committee (LARAC) http://www.larac.org.uk

Green Alliance - an independent charity promoting policies for a better environment. http://www.green-alliance.org.uk

Love Food Hate Waste

Further information and advice on reducing food waste can be found at: http://www.lovefoodhatewaste.com/

# Appendix H. Study Data and Models

H.1. WRATE Report; 'Recycling'

H.2. WRATE Report 'Residual Waste Treatment'

H.3. WRATE Report 'Organic Waste Treatment'

H.4. Excel File 'Environmental Options Appraisal Workbook'

H.5. Excel File 'Mass Flows and Costs Studies 2011/12 - 2030'

H.6. Excel File 'Electricity Revenue Study'