Bedfordshire County Council

Waste PFI

Options Appraisal Final Report

September 2008

Entec UK Limited

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Report for

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Executive Summary

Bedfordshire County Council (BCC), as a Waste Disposal Authority (WDA) has a statutory duty to dispose of waste delivered by the collection authorities of Bedfordshire, in addition to arisings collected at the Household Waste Recycling Centres (HWRCs). BCC, like many WDAs in England, dispose of residual waste arisings to landfill. To implement the landfill diversion and waste recovery aspects of the their municipal waste management strategy, together with managing fiscal measures such as Landfill Tax and the Landfill Allowance Trading Scheme, BCC needs to identify and procure a residual treatment alternative to landfill.

In 2004/05 Entec completed a Residual Waste Treatment Options Appraisal study for the Bedfordshire Authorities Waste Partnership (BAWP). This work supported the initial development of an Expression of Interest (EoI), which was submitted by BCC to the Department of Food and Rural Affairs (DEFRA). Due to conditions placed on the EOI approval by Defra, BCC decided to re-consider the options for securing residual waste treatment services.

BCC are now in a position to continue with their work in securing residual treatment capacity. However, in the intervening time (March 2005 to December 2007) there have been considerable developments in government waste policy, and within the waste management industry. In addition a new life-cycle assessment tool has been released by the Environment Agency.

The Defra funded Waste Infrastructure Delivery Programme (WIDP) has also issued a formal OBC template and guidance, with reporting requirements on the Options Appraisal and bankability of technologies. Although Bedfordshire is yet to determine its procurement route, it is appropriate that work undertaken at this stage should be compliant with current WIDP OBC guidance.

Whilst BCC were completing their Options Appraisal, Defra issued draft guidance on the Options Appraisal and the determination of the Reference Project for the Outline Business Case. This introduced the concept of the Full Economic Cost, including the Shadow Price of Carbon. BCC subsequently progressed their Options Appraisal in accordance with the new draft guidance.

The Options Appraisal first identified and weighted the appraisal criteria, and then defined the long list of options which were to be appraised. The appraisal processes produced a short-list of options taken forward for detailed modelling and financial appraisal. The short listed options for the treatment of residual waste were:

1. Energy from Waste- power only (EfW)
2. Energy from Waste, combined Heat and Power (EfW CHP)
3. Advance Thermal Treatment (gasification)
4. Mechanical Biological Treatment generating a Refuse Derived Fuel (RDF) for thermal treatment
5. Autoclave technology generating a RDF for thermal treatment.

In the appraisal of the short-listed options some of the appraisal criteria were amended either due to progress that the BCC had made elsewhere (site identification) or to reflect the new Defra draft guidance. The majority of the evaluation criteria and weightings remained the same as in the long-list evaluation.

The highest scoring option in this Options Appraisal is EfW with CHP with 98.8 marks. EfW is the second highest scoring option with 97 marks. Only 1.8 marks separate the top two scoring options. The third highest scoring option is MBT producing an RDF which is treated in an EfW. There is over a 21 point difference between the MBT option and the EfW option. Only 5 marks separate the bottom three options.

Contents

1. Introduction

1.1 Background

Bedfordshire County Council (BCC), together with the Waste Collection Authorities of Bedfordshire comprises the Bedfordshire Authorities Waste Partnership (BAWP). The BAWP published their Municipal Waste Management Strategy (MWMS) in 2006. The MWMS, adhered to the targets, policies and principals in Waste Strategy 2000[1] (England and Wales) and presented policies for waste reduction, recycling and composting, and waste recovery and landfill diversion.

The Landfill Allowance Trading Scheme (LATS), implemented under The Waste and Emissions Trading Act 2003, introduced a tradable permit system for the landfilling of Biodegradable Municipal Waste (BMW). This system aims to limit the amount of BMW that is sent to landfill by waste disposal authorities, thereby implementing the requirements of the Landfill Directive. Waste Disposal Authorities (WDA's) are issued with a set amount of allowances annually. Authorities can then either ensure that they do not exceed their annual limits each year or, if they intend to landfill more than their allowance, buy more permits from other authorities who may have a surplus. Whilst trading will deliver short-term benefits, the LATS system, combined with the increases in Landfill Tax will significantly increase the cost of landfilling.

BCC, as a Waste Disposal Authority (WDA) has a statutory duty to dispose of waste delivered by the collection authorities of Bedfordshire, in addition to arisings collected at the Household Waste Recycling Centres (HWRCs). BCC, like many WDAs in England, dispose of residual waste arisings to landfill. To implement the landfill diversion and waste recovery aspects of the MWMS, together with managing fiscal measures such as Landfill Tax and the Landfill Allowance Trading Scheme, BCC needs to identify and procure a residual treatment alternative to landfill.

In 2004/05 Entec completed a Residual Waste Treatment Options Appraisal study for the Bedfordshire Authorities Waste Partnership (BAWP). This included the identification of a long list of options and evaluation criteria. The criteria were weighted and the options scored to give a weighted score for each option. The top five ranking options were taken forward for detailed modelling, together with a WISARD Assessment. Details of option performance, scoring, and weighted scores were reported in Entec Report 05073 March 2005. This work supported the initial development of an Expression of Interest (EoI), this was subsequently submitted by BCC to the Department of Food and Rural Affairs (DEFRA) for potential support under the Project Finance Initiative (PFI). Due to conditions placed on the EOI approval by Defra, BCC decided to re-consider the options for securing residual waste treatment services.

BCC are now in a position to continue with their work in securing residual treatment capacity. However, in the intervening time (March 2005 to December 2007) there have been considerable developments in government waste policy, and within the waste management

[1] DETR, 2000. Waste Strategy 200 for England and Wales

industry. The Waste Strategy for England, published in May 2007[2], includes a new set of targets and indicators, including a new carbon indicator.

In addition a new life-cycle assessment tool has been released by the Environment Agency. Unlike WISARD, this tool is capable of modelling numerous residual treatment technologies, including several different types of Mechanical Biological Treatment (MBT) plant, gasification and pyrolysis plants as well as a range of Energy from Waste (EfW) facilities.

The Defra funded Waste Infrastructure Delivery Programme (WIDP) has also issued a formal OBC template and guidance, with reporting requirements on the Options Appraisal and bankability of technologies. Although Bedfordshire is yet to determine its procurement route, it is appropriate that work undertaken at this stage should be compliant with current WIDP OBC guidance.

1.2 Methodology

The initial long-listing and evaluation was completed in January 2005. This process identified a short list of options for detailed modelling, including financial modelling. Once this modelling was completed, it was the intention to re-evaluate the short-listed options in light of the additional information arising from the detailed modelling.

During the intervening period, Defra issued draft guidance on the Options Appraisal and the determination of the Reference Project for the Outline Business Case[3]. This introduced several key concepts:

- Appraisal criteria used in the options appraisal should also be used in the evaluation of solutions during the procurement process,
- price should not be scored: and
- the Full Economic Cost (FEC) should be considered.

The Full Economic Cost is to include not only the cost of the contractors charges (capital expenditure, operation expenditure and the cost of disposal of any residues (gate fee)) but also the cost of greenhouse gas emissions. These emissions are expressed as "a tonnage of carbon dioxide equivalents (CO_2e)" and "should be converted into a monetary value by applying the Shadow Price of Carbon (SPC)". The Defra guidance provides links to climate change pages on the Defra website which provides background information and further information. The draft guidance also states that as the cost of carbon emissions is included in the FEC, the impact of greenhouse gas emissions should not be included in the technical evaluation.

BCC wished to progress the Options Appraisal in accordance with the new draft guidance. Consequently, the evaluation of the WRATE output on global warming was removed from the technical evaluation. The WRATE output for greenhouse gas emissions was used to calculated the SPC, as defined in the Defra draft guidance, and used in determining the FEC.

[2] Defra, 2007. Waste Strategy for England 2007.

[3] Defra, 2008. Waste Infrastructure Delivery Programme Residual Waste Procurement Pack Module [] Part []. Options Appraisal and the Determination of the Reference Project for the Outline Business Case.

1.3 This Report

Section 2 of this report presents the appraisal of the long list of options. Section 3 of this report presents the appraisal of the short list of options. Section 4 of this report presents the sum of the technical and financial scores and discussion of the results.

2. Long-list Appraisal

2.1 Long-list of Options

The options considered relate not only to the type of technologies to be adopted, but also to the mass of material to be managed. In defining the list of options, a matrix, based on the principals of the waste hierarchy, was used. The matrix generates options based on all available residual treatment technologies but also in relation to waste minimisation initiatives, and recycling and composting levels. The matrix is presented in Table 2.1.

The BAWP is committed to waste minimisation and will work in partnership with the Waste Collection Authorities to promote waste awareness and minimisation. Their approach is to promote and implement waste minimisation measures and initiatives. Therefore the section of the matrix that relates to current waste minimisation activity is not relevant, and the Council will only consider options which have inherent waste minimisation within them.

Strategy 2007 sets an objective of achieving 50% recycling and composting by 2020. BCC wishes to see higher recycling rates delivered through public interfacing services (kerbside collections, bring schemes, HWRC services) and therefore only those options that included higher recycling were taken forward for consideration.

With regard to the residual treatment options, no potential technologies were excluded. Therefore the long-list of options is defined as the bottom row of the matrix presented in Table 2.1.

Additional permutations around the thermal treatment plants were also identified as options. This related to the size of the potential facilities and their capacity to deliver combined heat and power. As thermal treatment will divert all of the input biodegradable waste from landfill the facilities can either be sized to receive all available residual waste, or sufficient to meet the Landfill Allowance Trading Scheme allocations only.

Current recycling levels were incorporated in Option 1 “Do Nothing”. Options 2 to 14 include high (50%+) recycling and composting levels.

The options considered in this report are:

Option 1 Landfill – no increase in recycling “Do Nothing”;

Option 2 Landfill;

Option 3 Biodrying MBT - RDF to 3rd party burner;

Option 4 Biodrying MBT - RDF to purpose built burner;

Option 5 Bio-stabilise MBT - Residue to landfill;

Option 6 Autoclave – IVC;

Option 7 Autoclave – AD;

Option 8 Autoclave – RDF;

Option 9 EfW (capacity to meet LATS allocation);

Option 10:	EfW (capacity to receive all residual waste, minimise landfill);
Option 11	EfW with CHP (capacity to meet LATS allocation);
Option 12	EfW with CHP (capacity to receive all residual waste, minimise landfill);
Option 13	ATT - (capacity to meet LATS allocation); and
Option 14	ATT (capacity to receive all residual waste, minimise landfill).

Table 2.1 Matrix for Defining Long-list of Options for Residual Waste Management

Waste Min. Activity	Source Separation Recycling	Technology Options									
		Landfill	Mechanical and Biological Treatment			Autoclave			Incineration (EfW)		Advanced Thermal Treatment
		(for primary disposal)	Biodrying		Bio-stabilise	IVC	AD	RDF	EfW	EfW with CHP	ATT
			RDF to 3rd party burner	RDF to purpose built burner	Residue to landfill						
Maintain Level	Maintain Current Recycling										
	High Recycling										
Increase Waste Min. Activity	Maintain Current Recycling										
	High Recycling										

2.2 Defining and Weighting Technical Evaluation Criteria

An initial list of technical evaluation criteria was prepared by Entec and presented to the Project Board for discussion. The initial list of criteria were considered and, in consultation criteria added, removed and amended. The final list of criteria is presented in Table 2.2.

The evaluation criteria were identified as being the most important criteria against which the options would be evaluated. The criteria were chosen to reflect the environmental and social impacts of the options.

The individual criteria used for the options appraisal were weighted. The weighting exercise was undertaken in consultation with Project Board. This was designed to ensure that those criteria considered more important to Project Board and the local circumstances of Bedfordshire were properly reflected in the appraisal.

Criteria scores are multiplied by these weightings to provide a weighted score. Weightings are:

6 - Very highly important

5 – Highly Important

4 – High Medium Importance

3 – Medium importance

2 – Low Medium importance

1 - Less important

Each criterion was discussed separately and assigned a weighting. To ensure the effectiveness of this process there needs to be a reasonable spread of weightings, for example the weightings become in-effective if every criterion is rated either 5 or 6; highly important or very highly important.

Criterion 1 Recycling and Composting: Performance of Residual Treatment Technology. The Bedfordshire Waste Partnership is aiming to achieve a 50% recycling rate or higher prior to residual treatment. This recycling rate will be delivered in partnership between the Bedfordshire Authorities through the provision of services by the waste collection authorities at the kerbside and at bring sites and also by the County Council through recycling and composting provisions at the Household Waste and Recycling Centres. Given the high recycling and composting rates to be achieved through the front end services this particular indicator was considered less important in terms of delivering a residual waste treatment solution and was given a weighting of 1.

Criterion 2 Reliance of Residual Treatment Technology on Landfill: This criterion is not only about diversion of BMW from landfill, but about a technology's landfill requirements for all process residues. It is an assumption of this initial screening exercise that all biological treatment options will provide a compliant LATS solution. However some technologies will have higher diversion rates than others. Diversion from landfill (not only BMW) is an essential element of the residual treatment solution, and for this reason it was given a weighting of 6.

Criterion 3 Transport impact: The exact transport impacts of solutions are not quantifiable at this stage. This is because neither the site nor the destination of products and residues are known. For this analysis it is assumed that any solution will be a single site solution, and therefore transport into the facility will be the same across all options (the same tonnage is delivered to each facility from the same sources). However the tonnage of residues requiring disposal will vary and this can be used as a proxy for this indicator. Whilst transport impacts were deemed to be important, because they are unquantifiable and tonnage is to be used as a proxy, a weighting of 3 was agreed.

Criterion 4 Robustness and track record of the technology: The range of technology options assessed has increased over that available to be considered in 2005. It is important that the Council has a deliverable solution, and one aspect of deliverability is the proven track record of technologies. This proven track record needs to address not only size, i.e. the technology has been proven on a scale required by the BAWP, but also that the technology has operated with similar feed-stocks. Waste is very heterogeneous, and some technologies used to treat homogenous waste streams can experience operational difficulties with feed-stocks of a very heterogeneous nature. Robustness and track record was considered an essential element of the residual treatment solution and was weighted 6.

Criterion 5 Footprint and landtake: The different technologies have different footprints and land requirements. This indicator was given a weighting of three as BCC would need to purchase a site for the procurement process. The smaller the land take of the technology option then there is the possibility that more sites would be available for the development. As land costs may be lower (purchase of less land) the cost to the authority would subsequently be lower. This criterion was weighted 3.

Criterion 6 Planning risk for project timescales: All waste facilities are going to encounter planning issues, as, in general, the location of any waste facility within an area generates concerns and opposition from potential neighbours. The requirement to be able to secure planning permission within the project timescales is therefore highly important to the delivery of a residual waste treatment facility and consequently a weighting of 5 was agreed.

Criterion 7 Alignment to the BCC Carbon Agenda (Priority 10): The Council has a new long term carbon agenda, know as Priority 10 to “reduce the Council's carbon footprint and lead the County's response to climate change”. This is a high priority for the Council, as it is for the UK national government. The impacts of global warming, and the widespread publicity of targets to decrease carbon dioxide emissions led the group to allocate a high weighting (5) to this criterion.

Criterion 8 Technology Market: This criterion pertains to the capacity within the market to provide the technology and also the ability of contractors to bring these technologies to the table. This criterion, although important was not seen as highly important as it is recognised that the technology market is expanding and the capacity within the market is increasing. That said, some providers and technologies will experience greater capacity constraints than others, and as this capacity directly impacts the deliverability of the project a weighting of 3 was allocated to this criterion.

Criterion 9 Overall Off- take risk: The different technologies will all have different outputs which require management to ensure a complete solution is delivered. To deliver an affordable and deliverable solution the Council will wish to minimise the off-take risk of these products and residues, consequently this criterion was given a weighting of 4: High/Medium importance.

Criterion 10 Delivery of local socio-economic improvements: Any new development brings with it the prospect of new jobs. However it is not the primary purpose of BCC acting as the WDA, to create employment opportunities. BCCs main objective for this project is to procure a long term sustainable residual treatment facility for the management of residual wastes. Therefore this criterion was allocated a weighting of 2.

Criterion 11 Bankability: Most contractors will not be able to fund new developments "on balance sheet" (internal transfer of capital to the project). Instead they seek to secure loans from banks for the senior debt required to fund the project (project finance). Banks are generally risk adverse, and tend only to fund projects that guarantee a secure return on their investment. Banks are generally concerned about the reliability and performance of the technology to deliver the requirements of the contract, the potential for financial defaults and the ability to recover their investments in the event the contract terminates early. Generally public sector contractors are attractive to financial institutions, and the majority of waste technologies are bankable provided the contract structure is appropriate. This criterion was weighted 4.

Criterion 12 Consistent with local and national waste strategies: The options appraisal is for the management of residual waste in an environmentally and economically sustainable way. Considerable investment is already being provided by the BAWP towards waste minimisation initiatives and recycling and composting. The approach of the BAWP to this options appraisal is already consistent with local and national waste strategies and therefore this criterion was not weighted heavily with respect to the other criteria but given a weighting of 1.

Criterion 13 Maximise recovery value from waste: This indicator was weighted highly (5) with regard to the other indicators as the BAWP wish to ensure that the residual treatment solution maximises recovery of value from waste.

Criterion 14 Robustness of residual treatment technology to changes in feedstock: With a long term residual treatment contract it is important to try and ensure that the chosen technology would be able to adapt to changes in the material content, the physical form and chemical composition of the residual waste. As BCC is considering a long term contract, this indicator was deemed quite important and therefore given a weighting of 4.

2.3 Scoring

The scoring for each criterion was on a scale of 1 to 4, with 4 generally representing a good performance and 1 representing a poor performance.

The allocated weighting and scoring guidelines are provided in Table 2.2.

All criteria were deemed to be equally relevant to all Councils and the score allocated to each technology was determined by consensus between the Council representatives.

To maintain consistency when marking against each criterion, the evaluation team marked each solution in turn against the first criterion, each solution in turn against the second criterion and so on.

Criterion 1 Recycling and Composting Performance of Residual Treatment Technology: MBT and the autoclave technologies are designed to recover materials for recycling unlike thermal treatment options. However, given the improved recycling and composting rate

through kerbside, bring and HWRC service it is envisaged that this will be a moderate increase in the overall recycling and composting performance. It is important to recognise that in order to count toward recycling figures the materials need to be segregated and sent for recycling. For some materials, for example plastic film, the claim of technology providers to recycle these materials are not always deliverable, as no market exists to recycle these materials. In some instances the quality of material recovered within the processes is below a minimum market standard.

Criterion 2 Reliance of Residual Treatment Technology on Landfill: Technologies that have significant residue streams requiring landfill will score less than those options that have a lower landfill requirement. Thermal treatment scored higher than other treatment processes as the mass of process residues requiring landfill is typically low; furthermore any residues that are landfilled will have zero BMW content. Of the thermal treatment options, those that meet LATS scored lower than the options that diverted all the waste. Options that may have some waste or process outputs going to landfill (such as IVC and AD) were scored higher than options with a complete reliance on landfill. It was agreed that the disposal of compost like products from composting MBTs is still an issue, and there is high risk that such a product would need to be landfilled.

Criterion 3 Transport impact: This impact is was determined using process outputs as a proxy. Options that will completely divert waste from landfill (i.e. those options that would require no travel to landfill out of the County) scored higher than those that would need some travel to landfill (i.e. options that only meet LATS) and these options scored higher than those that didn't divert much waste from landfill; i.e. those producing a compost like product (CLP).

Criterion 4 Robustness and track record of the technology: Options that are less proven, scored lower against this criterion. The more proven the technology the higher the score. EfW and EfW CHP is a well proven technology in the UK, with several plants operating at capacities likely to be required for Bedfordshire. There are many MBT plants operational across the continent but the technology is not so well proven in the UK, with a limited number of plants. Although ATT is a proven technology on homogenous feedstocks, the very heterogeneous nature of MSW has provided technological difficulties in technology transfer into the municipal waste sector. The application of ATT within the municipal waste sector is generally confined to receipt of a product i.e. an RDF/SRF from a pre-treatment technology such as MBT or Autoclave. Similarly, as there are no large scale autoclave plants operational in the UK the ATT and autoclave options scored lower than MBT.

Criterion 5 Footprint and landtake: In general a thermal treatment plant will have a lower footprint than an MBT. A composting MBT will have a much greater land take due to the substantial area needed for composting and also maturation. MBT options scored the same as landfill (1) due to the large amount of space that is required to store the waste and process it through the various treatment options. Thermal treatment options scored highest although where only LATS diversion is sought the score decreases as land take for landfill would also be required.

Criterion 6 Planning risk for project timescales: As detailed above, all new waste facilities generally encounter planning issues**.** Therefore it was agreed that any new facilities were given the same scoring. Any option with a large amount of waste going to landfill (options 1 and 2 and MBT to landfill) were scored below the new facilities due to the requirement to secure increasingly scare landfill capacity. Option 3 (Biodrying MBT to third party RDF

burner) scored the highest as the thermal treatment element of facility would already exist and consequently this option could incur the lowest planning risk.

Criterion 7 Alignment to the BCC Carbon Agenda (Priority 10): Scoring at this initial stage was completed using professional judgement as no WRATE modelling had been completed. At this stage in the process the Defra draft guidance had not been issued, and this criterion remained within the technical evaluation. Those technologies that retained a large element of landfill scored lower than technologies that treated all residual wastes. The Autoclave scored the highest due to the greater quantity of material recycling from this solution. EfW CHP scored higher that EfW due to the greater efficiencies achieved through the use of heat.

Criterion 8 Technology Market: Scoring this criterion relates not only to how many providers of a particular technology there are, but also the capacity the providers have in supplying the particular technologies. There are many established EfW providers within the existing markets; several of the large waste management companies operating within the UK have experience of bidding contracts with EfW solutions and also delivering these solutions. The number of MBT providers has been increasing, and the number of waste management companies offering this as a solution has also developed, however the market for MBT within the UK is not as advanced and therefore may not have the same capacity as EfW. There are fewer providers of ATT and Autoclave technologies and due to their smaller size it is reasonable to assume the capacity of these providers is below those of MBT and EfW.

Criterion 9 Overall Off- take risk: As landfill does not have any residues, and therefore no off-take risk this scored highest of all the options. All other options, except EfW CHP, MBT RDF to 3rd Party and Autoclave IVC scored the same as the relative risks associated with the products were deemed equivalent. EfW CHP scored lower than EfW as, while there is a market for electricity through the national grid; any heat off-take needs to be local. It can be difficult to find a major heat user whose heat requirements dove-tail with the development and operation of EfW facilities. Similarly 3rd part risks for the thermal treatment of the RDF output from an MBT exist where no dedicated thermal treatment plant is developed. The Autoclave IVC was scored lower than the other Autoclave solutions because of the volume and nature of the product. Even though the Autoclave would sterilise the biogenic output sent for composting, the Animal By-Product Regulations (ABPR) regulations would restrict the Compost Like Product (CLP) application to land because it was not source segregated. It was agreed that at present the routes for disposal would be limited and therefore carried greater risk.

Criterion 10 Delivery of local socio-economic improvements: With the exception of landfill which scores 1, all other options scored the same (2) because at this stage it is difficult to assess how one option will differ to another without knowing sizes and economies of scale.

Criterion 11 Bankability: Proven options for dealing with residual waste are more likely to attract project finance (landfill and EfW) as they provide a lower financial risk. EfW scores the highest because it is the most understood technology that has been applied world wide on many different waste streams. The same technology can receive a relatively wide range of feedstocks and still operate reliably making the technology generally bankable. Autoclave and ATT score the lowest because these technologies have a very limited or reliable track record and consequently banks will have greater concern with over performance and potential for Contract default.

Criterion 12 Consistent with local and national waste strategies: Any option that doesn't fully divert the total available residual waste from landfill was scored low at a 2, with landfill

receiving the lowest score. Autoclave to AD and RDF scored the highest because it was agreed that there could be a greater element of recycling and recovery in these options compared with the others. EfW to CHP also receive a high score due to the high thermal efficiency of this option.

Criterion 13 Maximise recovery value from waste: EfW and EfW CHP that maximise diversion scored highest as there would be more use of the total residual waste. All the thermal treatments, Autoclave to AD and Autoclave to RDF burner and MBT to RDF burners scored higher than the remaining options as energy in the waste can be captured.

Criterion 14 Robustness of residual treatment technology to changes in feedstock: Some technologies have broader windows of operation than others. Landfill is probably the most robust, and scores highest (4). Apart from acceptance criteria laid down by law, there is physically, biologically and chemically few constraints on the landfill of materials (provided it is conducted in a safe manner). Autoclave with an RDF burner also scored a 4. This is due to the ability of the two components to treat a range of waste types (i.e. wet waste and high calorific waste). The biostabilising MBT scored lower (2) than the other MBT options (3) as the process purely reduces the BMW content of the waste, where as biodrying produces an RDF suitable for burning and is not as sensitive to composition changes. ATT was also scored at 2 as these are technologies are more sensitive to the physical form of the feedstock and already requires an element of pre-treatment. All other options were scored equally at 3.

Table 2.2 Weighting and Scoring Mechanism for Assessment Criteria

Criteria		Weighting	Scoring
1	Recycling and compost performance of residual treatment technology	1	1: No additional recycling/composting 2: Low Increase of recycling/composting performance 3: Moderate improvement of recycling/composting performance 4: High Improvement of recycling/composting performance
2	Reliance on Landfill	6	1: High Landfill 2: Moderate Landfill- Uncertainty over ability to meet LATS targets 3: Moderate landfill - Meets LATS in the medium to long term 4: Minimise landfill- Likely to have significant LATS surplus
3	Transport Impact	3	1: Significant haulage of products and residues 2: High haulage of products and residues 3: Moderate haulage 4: Limited haulage
4	Robustness and 'track record' of technology	6	1: Solution includes unproven technology 2: Solution includes technology only proven at pilot scale 3: Solution includes limited proven technology (e.g. limited track record) 4: Solution includes proven technology with good track record.
5	Footprint and Landtake	3	1: Large footprint, major land take required 2: Large footprint, high land-take required 3: Moderate footprint, moderate land-take required 4: Moderate footprint, minimal land-take required
6	Planning risk for project timescales	5	1: Likely to encounter significant planning delay 2: Probably encounter planning delay 3: Potential planning delay 4: Minimal planning delay
7	Alignment to the BCC Carbon Agenda (Priority 10)	5	1: No alignment, no carbon reduction 2: Moderate alignment, carbon reduction 3:Good alignment, carbon savings 4: Excellent alignment, significant carbon savings
8	Technology Market	3	1:Minimal, no market: poor competition 2:Poor market appetite: moderate to low competition 3:Reasonable market appetite: reasonable competition 4:Excellent market appetite: good competition
9	Overall Off-take risk	4	1: Very poor / no market for products/residues: significant risk 2: Poor market for products/residues: moderate risk 3: Reasonable market for products/residues: low risk 4: Excellent Market for products/residues; minimal risk
10	Delivery of local socio- economic improvements	2	1: No socio-economic benefits 2: Limited jobs, limited opportunities for expanding markets 3: New jobs & markets 4: New jobs & stimulates secondary markets
11	Bankability (Contractor Funding)	4	1: Unlikely to get project finance, poor bankability 2: Difficult to get project finance, poor bankability 3: Can get project finance, moderate bankability 4: Readily bankable,
12	Consistent with local and national waste strategies	1	1: Solution conflicts with local and national waste strategies 2: Solution not in line with local and national waste strategies 3: Solution in line with local and national waste strategies 4: Solution fully supports local and national waste strategies
13	Maximise recovery value from waste	5	1:No additional recovery 2: Limited additional recovery of materials 3: Moderate additional recovery of materials 4:Maximises recovery
14	Robustness of residual treatment technology to changes in feedstock	4	1: Unable to manage changes in feedstock 2: Limited scope to manage changes in feedstock 3: Moderate scope to manage changes in feedstock 4: Good scope to manage changes in feedstock

Table 2.4 presents the marks allocated for each waste management option (as identified in Table 2.3) against the various evaluation criteria. Table 2.5 and Figure 2.1 present the weighted scores for each option against evaluation criteria. Table 2.6 presents the totalled overall scores and ranking for each option considered.

Table 2.3 The Long List of Technology Options

Option	Treatment Type
1	Landfill – no increase in recycling "Do Nothing";
2	Landfill;
3	Biodrying MBT - RDF to 3rd party burner;
4	Biodrying MBT - RDF to purpose built burner;
5	Bio-stabilise MBT - Residue to landfill;
6	Autoclave – IVC;
7	Autoclave – AD;
8	Autoclave – RDF;
9	EfW (capacity to meet LATS allocation);
10	EfW (capacity to receive all residual waste, minimise landfill);
11	EfW with CHP (capacity to meet LATS allocation);
12	EfW with CHP (capacity to receive all residual waste, minimise landfill);
13	ATT - (capacity to meet LATS allocation); and
14	ATT (capacity to receive all residual waste, minimise landfill).

Table 2.4 Scores for each Waste Management Option

Criteria	Weighting	Criteria	Options													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	Recycling and compost performance or residual treatment technology	1	1	2	2	2	2	2	2	2	2	2	2	2	2
2	6	Reliance on Landfill	1	1	3	3	2	2	2	3	3	4	3	4	3	4
3	3	Transport Impact	1	1	2	3	1	1	1	3	2	4	2	4	2	4
4	6	Robustness and 'track record' of technology	4	4	3	3	3	2	2	2	4	4	3	3	2	2
5	3	Footprint and Landtake	1	1	1	1	1	2	2	2	3	4	3	4	3	4
6	5	Planning risk for project timescales	1	1	3	2	1	2	2	2	2	2	2	2	2	2
7	5	Alignment to the BCC Carbon Agenda (Priority 10)	1	1	2	2	3	2	4	4	3	3	4	4	3	3
8	3	Technology Market	1	1	3	3	3	2	2	2	4	4	4	4	2	2
9	4	Overall Off-take risk	4	4	2	3	3	4	3	3	3	3	2	2	3	3
10	2	Delivery of local socio- economic improvements	1	1	2	2	2	2	2	2	2	2	2	2	2	2
11	4	Bankability (Project Finance)	4	4	2	3	3	2	2	2	4	4	2	2	2	2
12	1	Consistent with local and national waste strategies	1	1	3	3	2	3	3	4	2	3	2	3	2	3
13	5	Maximise recovery value from waste	1	1	3	3	2	2	3	3	3	4	3	4	3	3
14	4	Robustness of residual treatment technology to changes in feedstock	4	4	3	3	2	3	3	4	3	3	3	3	2	2

Table 2.5 Weighted Scoring for each Waste Management Option

Criteria	Weighting	Criteria	Options													
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	1	Recycling and compost performance or residual treatment technology	1	1	2	2	2	2	2	2	2	2	2	2	2	2
2	6	Reliance on Landfill	6	6	18	18	12	12	12	18	18	24	18	24	18	24
3	3	Transport Impact	3	3	6	9	3	3	3	9	6	12	6	12	6	12
4	6	Robustness and 'track record' of technology	24	24	18	18	18	12	12	12	24	24	18	18	12	12
5	3	Footprint and Landtake	3	3	3	3	3	6	6	6	9	12	9	12	9	12
6	5	Planning risk for project timescales	5	5	15	10	5	10	10	10	10	10	10	10	10	10
7	5	Alignment to the BCC Carbon Agenda (Priority 10)	5	5	15	15	10	15	20	20	15	15	20	20	15	15
8	3	Technology Market	3	3	9	9	9	6	6	6	12	12	12	12	6	6
9	4	Overall Off-take risk	16	16	8	12	12	8	12	12	12	12	8	8	12	12
10	2	Delivery of local socio- economic improvements	2	2	4	4	4	4	4	4	4	4	4	4	4	4
11	4	Bankability (Project Finance)	16	16	8	12	12	8	8	8	16	16	8	8	8	8
12	1	Consistent with local and national waste strategies	1	1	3	3	2	3	3	4	2	3	2	3	2	3
13	5	Maximise recovery value from waste	5	5	15	15	10	10	15	15	15	20	15	20	15	15
14	4	Robustness of residual treatment technology to changes in feedstock	16	16	12	12	8	12	12	16	12	12	12	12	8	8
Total Weighted Score			106	106	136	**142**	110	111	125	**142**	**157**	**178**	**144**	**165**	127	**143**

Figure 2.1 Weighted Scoring for each Waste Management Option

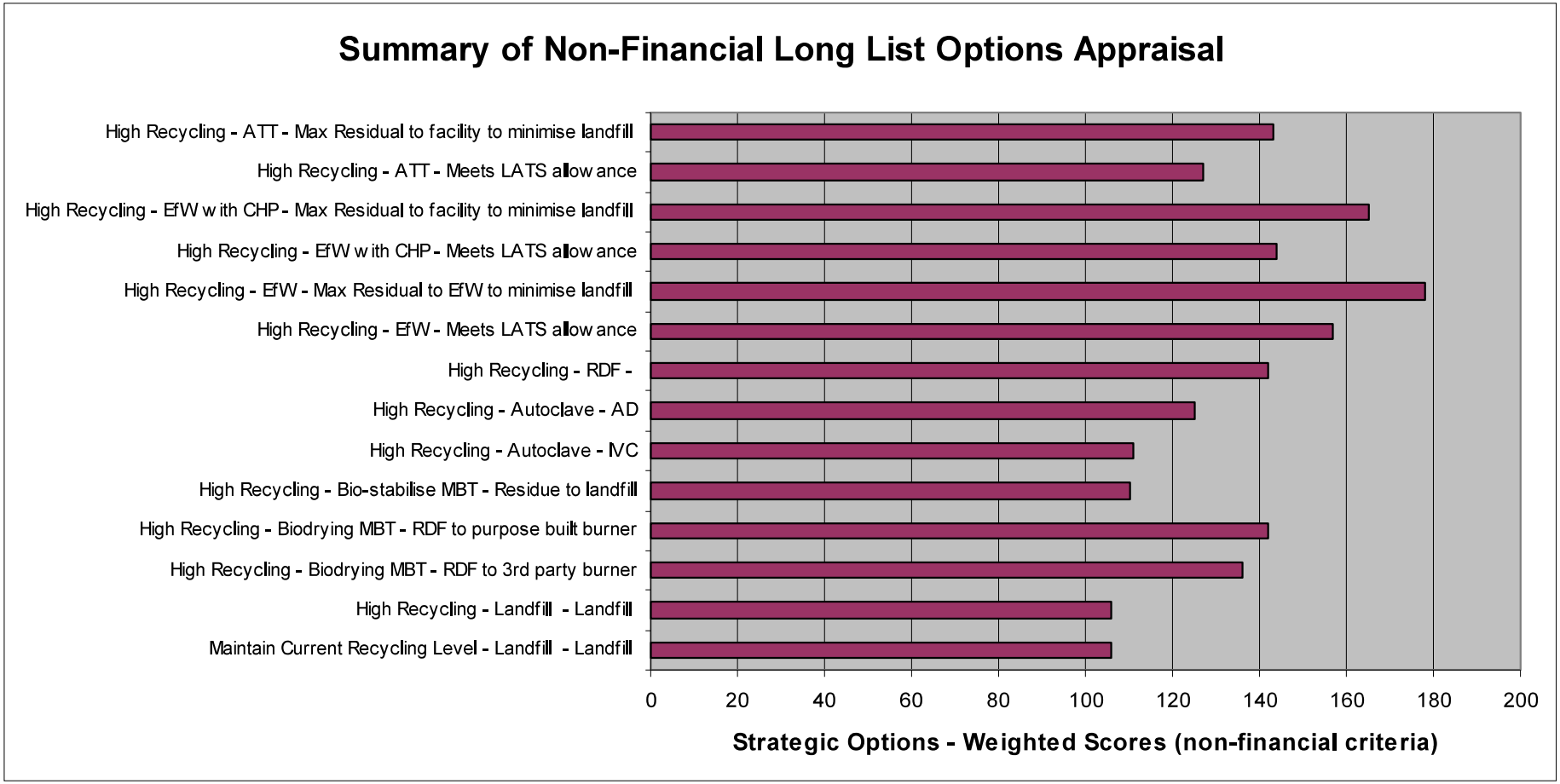

Table 2.6 Total Weighted Scores and Rankings

Strategic Option	Weighted Score
High Recycling - EfW - Max Residual to EfW to minimise landfill	178
High Recycling - EfW with CHP - Max Residual to facility to minimise landfill	172
High Recycling - EfW - Meets LATS allowance	157
High Recycling - EfW with CHP - Meets LATS allowance	154
High Recycling - ATT - Max Residual to facility to minimise landfill	143
High Recycling - Biodrying MBT - RDF to purpose built burner	142
High Recycling - Autoclave - RDF	142
High Recycling - Biodrying MBT - RDF to 3rd party burner	136
High Recycling - Autoclave - AD	132
High Recycling - ATT - Meets LATS allowance	130
High Recycling - Autoclave - IVC	114
High Recycling - Bio-stabilise MBT - Residue to landfill	110
Maintain Current Recycling Level - Landfill - Landfill	106
High Recycling - Landfill - Landfill	106

2.4 Discussion of Rankings

The best performing options differed by 6 points and were high recycling with residual waste to EfW to minimise landfill and high recycling with residual waste to an EfW CHP facility to minimise landfill. With a gap of 15 points between the 2nd and 3rd options, the 3rd and 4th options only differed by 3 points. These were residual to EfW and EfW CHP sufficient to meet LATS. Another gap of 11 points separated 3rd and 4th ranked options from the next grouping of three options, which were themselves separated by only 1 point. These were residual waste to an ATT, residual waste to a MBT producing a RDF, and residual waste to an Autoclave producing a RDF.

BCC reviewed the results and it was agreed to take the following 5 options forward for detailed modelling and financial appraisal. They all have high recycling delivered through kerbside schemes, bring banks and HWRCs, but differ in the manner of residual waste treatment. The short listed options for the treatment of residual waste were:

1. Energy from Waste- power only (EfW)
2. Energy from Waste, combined Heat and Power (EfW CHP)
3. Advance Thermal Treatment (gasification)
4. Mechanical Biological Treatment generating a RDF for thermal treatment

5. Autoclave technology generating a RDF for thermal treatment.

Of the top seven performing options two were dismissed prior to short listing. They were the EfW and EfW to CHP sufficient to meet LATS. These were not regarded as technically discrete options and their selection could restrict choice even though they performed well in the options appraisal. By excluding these two options BCC were not eliminating any particular technologies; indeed by eliminating these two the technology field was broadened to include the three following options, each of which was a different technology option. It was felt that this would afford a more robust second evaluation than comparing fundamentally one technology, EfW, around a range of parameters; tonnage and heat/power off-take.

The five options were modelled technically, using Entec's mass flow model. The options were also modelled in WRATE and the financial outputs modelled by BCC's financial consultants Grant Thornton.

ATT technologies will, in general, require an element of pre-treatment. This need not be as advanced as MBT or Autoclaving, but to ensure good combustion in the gasification and pyrolysis technologies, waste requires pre-treatment and homogenisation. To allow this option to be modelled in WRATE, the ATT option included mechanical pre-treatment to remove metals and inerts for recycling and shredding of the remaining waste. These elements were also costed in the mass flow model and financial modelling.

2.5 Technical, WRATE and Financial Modelling

2.5.1 Technical Modelling

To complete the technical modelling a series of assumptions were necessary. The main assumptions driving the modelling are:

- Waste composition;
- Waste growth; and
- Recycling scheme performance.

Together these three assumptions determine how much residual waste requires treatment.

Other assumptions include facility operational parameters, facility costs, landfill tax assumptions and LATS assumptions.

To accompany the model Entec produced a Modelling Report (Entec Report 08397i1).

2.5.2 WRATE Modelling

WRATE measures all impacts and benefits associated with each stage of the overall waste solution. Environmental Impacts are measured in terms of emissions from individual processes, including emissions to air, land and the water environment. Environmental benefits are realised where materials or energy are recovered through a process and thereby off-set the requirements to use virgin resources, these benefits are measured in terms of emission savings to the environment.

Default Impacts show the Environmental Impact of a service in terms of six key impacts. These impacts are calculated using WRATE through the use of equivalents, whereby identified emissions are converted into the relative impact of a known substance. The use of equivalents may be familiar to the reader in terms of Global Warming Potential, where all individual greenhouse gas emissions are measured in relation to their potential impact in terms of carbon dioxide emissions. Default Impacts utilised in WRATE have been chosen by the Environment Agency. The following default impacts are measured within the WRATE LCA software.

Abiotic Resource Depletion (kg antimony equivalent) – Use of non-renewable and renewable resources. Abiotic resources are non-living things, including land, water, air and minerals.

Global Warming Potential (kg carbon dioxide equivalent) – Measure of what mass of Greenhouse Gases are estimated to contribute to global warming, a relative scale that compares emissions to Carbon Dioxide.

Human Toxicity (kg 1,4-dichlorobenzene equivalent) – This covers a number of different effects: acute toxicity, irritation/corrosive effects, allergenic effects, irreversible damage/organ damage, genotoxicity, carcinogenic effects, toxicity to reproductive system/teratogenic effects, and neurotoxicity. The equivalence factors are determined for emissions to different compartments: air, water, and soil and exposure via different media: air water, and soil. This impact has a high level of uncertainty associated with it due to differences in available scientific data.

Freshwater Aquatic Ecotoxicity (kg 1,4-dichlorobenze equivalent) – Toxicity towards ecosystems can be regarded as either chronic (causing long lasting illness) or acute (short term/ immediate effects).

Acidification (kg Sulphur Dioxide equivalent) – Emissions of acidifying compounds such as sulphur dioxide and nitrous oxides that attack leaves and acidify the soil which can result to changes in the ecosystem.

Eutrophication (kg Phosphate equivalent) - is caused by the increase of chemical nutrients, typically compounds containing nitrogen or phosphorus.

WRATE includes a 'Normalisation' function which allows the Default Impacts to be presented on the same graph and, potentially, also allows an impact to be assessed within an accessible context. Normalisation is the number of 'average' European people who would cause the same impact over the course of a year.

Outputs from the technical modelling on mass flows etc. were used in the WRATE modelling.

Further details of the WRATE software and modelling are reported in Entec WRATE Final Report 08378i1.

2.5.3 Financial Modelling

Financial modelling was completed by Grant Thornton LLP and reported separately.

3. Short-list Options Evaluation

3.1 Evaluation Methodology

The Evaluation methodology was agreed with BCC prior to re-visiting the scoring exercise.

At this stage of the options appraisal an assessment of the financial implications of each of the options was included. The evaluation was divided into two sections and weighted as follows;

Technical Performance criteria	40%
Financial criteria.	60%

The weightings were selected by the Project Board based on current standard procurement weightings.

The option that has the highest mark allocation (technical marks plus financial marks) will be identified as the preferred option. This option will be worked up into the Reference Project for the purposes of developing an Outline Business Case.

Subsequent to this agreement the Defra draft guidance on Options Appraisals was issued. This required a re-evaluation of the adopted methodology.

BCC wished to adhere to current Defra guidance, albeit draft guidance. Consequently the criterion that related to greenhouse gas emissions was removed from the technical scoring matrix.

Financial consultants, Grant Thornton, calculated the FEC, using the WRATE output data and SPC methodology. The FEC was adopted as the financial assessment.

3.2 Technical Performance Criteria

3.2.1 Review of Technical Criteria and weighting

Subsequent to the long list evaluation Defra published a Draft Guidance for Options Appraisal and the Determination of the Reference Project for the Outline Business Case. The technical areas proposed in this draft guidance document can be broadly mapped to BCCs identified technical evaluation criteria.

Prior to the commencement of the evaluation of the short-listed options, the technical criteria and their weightings were debated in light of the draft guidance, the development of the mass flow modelling and WRATE assessment.

The WRATE software provides a calculation of greenhouse gas emissions derived from a particular solution. It was agreed that the criterion "Alignment of BCCs Carbon Agenda" be re-phrased to read "WRATE Greenhouse Gas potential as this would allow the indicator to be quantifiable (in WRATE terms). There was not another criterion that could be "mapped" to the remaining environmental indicators provided by WRATE. Therefore a new criterion "Other

WRATE indicators" was added. It was agreed that this criterion should have the same weighting as for greenhouse gases, and was therefore weighted five.

Since the previous long list evaluation BCC had made some advances in identifying and acquiring a site. As all the technology options would be able to deliver a solution on this site a discussion on the relevance of the criterion "Footprint and landtake" was held. It was agreed that for consistency this criterion would not be removed, but as all options could be delivered on the identified site, all options would score equal for this criterion.

It was also agreed that, as this stage of the evaluation was to concentrate on the residual treatment element, and not on the whole solution, the weighting for recycling and composting performance should be increased.

As none of the residual treatment options included composting, the wording of the "Recycling and compost performance of residual treatment technology" indicator was changed to "Recycling performance of residual treatment technology".

The revised criteria wording and weightings are presented in Table 3.1.

Table 3.1 Revised Assessment Criteria and Weightings

Criteria		Weighting	Scoring
1	Recycling performance of residual treatment technology	**3**	Scored between 1 and 4 using mathematical formula
2	Reliance on landfill	6	Scored between 1 and 4 using mathematical formula
3	Transport Impact	3	Scored between 1 and 4 using mathematical formula
4	Robustness and 'track record' of technology	6	1: Solution includes unproven technology 2: Solution includes technology only proven at pilot scale 3: Solution includes limited proven technology (e.g. limited track record) 4: Solution includes proven technology with good track record
5	Footprint and Landtake	3	**4: Proposed site large enough to accommodate all technologies**
6	Planning risk for project timescales	5	1: Likely to encounter significant planning delay 2: Probably encounter planning delay 3: Potential planning delay 4: Minimal planning delay
7	Greenhouse Gas Emissions- No Longer a technical evaluation criterion; moved to calculated FEC		
8	Technology Market	3	1: Few providers low capacity 2: Few providers: moderate capacity 3: Several providers ; moderate capacity 4: Several providers; good capacity
9	Overall off-take risk	4	1: Very poor / no market for products/residues: significant risk 2: Poor market for products/residues: moderate risk 3: Reasonable market for products/residues: low risk 4: Excellent Market for products/residues; minimal risk
10	Delivery of local socio- economic improvements	2	1: No socio-economic benefits 2: Limited jobs, limited opportunities for expanding markets 3: New jobs & markets 4: New jobs & stimulates secondary markets
11	Bankability (Contractor Funding)	4	1: Unlikely to get project finance, poor bankability 2: Difficult to get project finance, poor bankability 3: Can get project finance, moderate bankability 4: Readily bankable,
12	Consistent with local and national waste strategies	1	1: Solution conflicts with local and national waste 2: Solution not in line with local and national waste 3: Solution in line with local and national waste 4: Solution fully supports local and national waste
13	Maximise recovery value from waste	5	Scored between 1 and 4 using mathematical formula
14	Robustness of residual treatment technology to changes in feedstock	4	1: Unable to manage changes in feedstock 2: Limited scope to manage changes in feedstock 3: Moderate scope to manage changes in feedstock 4: Good scope to manage changes in feedstock
15	Other WRATE indicators	5	Scored between 1 and 4 using mathematical formula

3.2.2 Review of Scoring Methodology

The scoring matrix used a scoring system between 1 and 4, with 1 being the lowest mark available and 4 being the highest. This second stage of the technical evaluation was based on the evaluation of the five short-listed technologies to treat residual waste.

The modelled data has provided outputs that can be scored relative to one another through a formula that allows the best performing option to score 4. The formula is as follows:

4 x (option score/best option score)

The only issue with this approach was with the WRATE Greenhouse Gas criterion, as this had both negative and positive results. This was resolved by adopting the following formula:

4 x ((option score/highest score))/(lowest score - highest score)

where negative is a benefit and therefore the highest score, and where a positive is an impact and therefore the lowest score.

3.3 Technical Scoring of Short-listed Options

The detailed modelling and WRATE assessment provided data which allowed for some of the criteria to be quantified. Where this was a case the scoring was completed using a mathematical formula. The criteria scored using modelled data were:

- Recycling performance of residual treatment technology;
- Reliance on landfill;
- Transport impact;
- WRATE-other indicators; and
- Maximise recovery value from waste.

All criteria scores were reviewed. Criteria scores not changed from the long-list evaluation were:

- Robustness and 'track record' of technology;
- Planning risk for project timescales;
- Technology market;
- Delivery of local socio- economic improvements;
- Bankability (project finance); and
- Robustness of residual treatment technology to changes in feedstock.

Two criteria scores were amended:

- Overall off-take risk; and
- Consistent with local and national waste strategies.

Recycling performance of residual treatment technology

The modelled recycling tonnages from each option were taken from the mass flow model. A discussion was held on the inclusion of metal recycling from the EfW and EfW CHP. BCC determined that metal recycling from EfW should be included because while it did not count towards BVPI 82a performance, the metal was still recycled. If it was not included in this indicator, then its inclusion would not be assessed anywhere else in this appraisal. Incinerator bottom ash (IBA) can be recycled as a secondary aggregate. However whereas there is an established, guaranteed market for the metals, the same is not true for IBA. Therefore a prudent assumption was adopted that IBA should not count towards recycling, as there is no certainty that it will be recycled.

The modelled data for recycling for each of the technologies were:

Option	Tonnes	Score
EfW	3,153	1
EfW CHP	3,153	1
ATT	10,684	2
MBT RDF to EfW	13,538	2
Autoclave & RDF to EfW	23,128	4

The EfW recycling data is derived from the assumption that 3% of the input tonnage is recoverable metals. The recovery of metals for recycling in modern plants is well established. The ATT recyclable tonnage is calculated on the basis that metals are recovered, 50% of glass is recycled and inert materials are recovered for recycling. The MBT recycling tonnage is based on the recycling of metals, glass and fines, and the Autoclave tonnage is based on the recycling of metals, glass, plastics and fines.

Reliance on landfill

This was quantified by the material sent to landfill, and included bottom ashes, fly ashes and residues from any MBT or Autoclave process. The modelled data and associated scores were:

Option	Tonnes	Score
EfW	29,425	3
EfW CHP	29,425	3
ATT	18,980	4
MBT RDF to EfW	34,120	2
Autoclave & RDF to EfW	31,373	2

Transport impact

As in the initial assessment the exact transport impacts of solutions are not quantifiable at this stage. Although progress has been made on site identification and therefore transport impacts

into the facility could be estimated, these would be the same for all the options (except the Do Nothing option of landfill). However, what is quantifiable is the tonnage of material (either recyclables or residues) requiring transport. BCC recognise that some products and residues will be transported different distances, but again this is unquantifiable; some residues such as bottom ashes may only be transported short distances, some recyclable material may even be exported. As it is impossible to predict how far products and residues will be transported BCC opted for the simple proxy of total tonnage requiring transporting.

Option	Tonnes	Score
EfW	32,425	4
EfW CHP	32,425	4
ATT	28,980	4
MBT RDF to EfW	47,120	3
Autoclave & RDF to EfW	54,373	2

WRATE-other indicators:

WRATE includes a 'Normalisation' function which allows the Default Impacts to be presented on the same graph and, potentially, also allows an impact to be assessed within an accessible context. Normalisation is the number of 'average' European people who would cause the same impact over the course of a year. BCC discussed how this criterion should be assessed, and agreed that the European Person Equivalent function within WRATE would be used. The outputs for the other standard indicators (Abiotic Resource Depletion (kg antimony equivalent) Measure of Human Toxicity (kg 1,4-dichlorobenzene equivalent) –Freshwater Aquatic Ecotoxicity (kg 1,4-dichlorobenze equivalent) Acidification (kg Sulphur Dioxide equivalent), Eutrophication (kg Phosphate equivalent**))** were converted to their European Person Equivalents and summed. The results are presented below together with the scores.

Option	European Person Equivalent	Score
EfW	-13,809	3
EfW CHP	-14,399	3
ATT	-19,487	3
MBT RDF to EfW	-31,769	4
Autoclave & RDF to EfW	-33,728	4

Maximise recovery value from waste:

The mass flow model provided outputs for energy recovery, expressed in MegaWatt hours. These outputs were calculated based on Calorific Value (CV), tonnage and efficiencies within

the combustion processes modelled (EfW, gasification etc). This information is presented in Entec modelling report 08397i1. In this modelling a conservative view of CHP was taken and no income was assigned to the potential heat/steam recovery. However for this options appraisal exercise it was important to have an understanding of the improved efficiencies from an EfW CHP option. To enable this assessment an assumption of the ratio of steam to power was made. This ratio will be a function of several different parameters, not least of which will be the market availability for the heat off take (a domestic heating system will have heat demand fluctuations, an industrial application may not). For this exercise a ratio of approximately 50:50 was assumed, as this is similar to ratios at existing facilities, for example the Sheffield CHP facility.

Option	MWh	Score
EfW	59,900	2
EfW CHP	106,194	4
ATT	52,721	2
MBT RDF to EfW	27,766	1
Autoclave & RDF to EfW	21,867	1

Overall off-take risk: EfW scored high as there is minimal risk in the off-take of electrical generation. Therefore EfW was increased from a three to a four. All other options remained the same.

Consistent with local and national waste strategies: The highest scoring options were EfW-CHP, and autoclave, with MBT, ATT, and EfW scoring three. However it was felt that the additional recycling of the ATT compared to the EfW and, the additional energy recovery of the ATT compared to the MBT should mean that the ATT should score higher that these other two options. The ATT score was consequently increased from a three to a four.

Table 3.2 presents the option scores together with the total weighted score.

Table 3.2 Scores for each Waste Management Option

No.	Weighting	Criterion	1	2	3	4	5
1	3	Recycling performance of residual treatment technology	1	1	2	2	4
2	6	Reliance on landfill	3	3	4	2	2
3	3	Transport impact	4	4	4	3	2
4	6	Robustness and 'track record' of technology	4	4	2	3	2
5	3	Footprint and landtake	4	4	4	4	4
6	5	Planning risk for project timescales	2	2	2	2	2
7		WRATE GHG Emissions- No longer assessed here					
8	3	Technology market	4	4	2	3	2
9	4	Overall off-take risk	4	2	3	3	3
10	2	Delivery of local socio- economic improvements	2	2	2	2	2
11	4	Bankability (project finance)	4	2	2	3	2
12	1	Consistent with local and national waste strategies	3	4	4	3	4
13	5	Maximise recovery value from waste	2	4	2	1	1
14	4	Robustness of residual treatment technology to changes in feedstock	3	3	2	3	4
15	5	Other WRATE indicators	2	2	2	4	2
Total Weighted Score			**166**	**161**	**142**	**148**	**133**
As a percentage of total weighted score available			**77%**	**75%**	**66%**	**69%**	**62%**

3.4 Technical Results and Discussion

EfW scored the highest with 166 or 77% of the total weighted score. EfW CHP was the second highest technical score with 161 or 75% of the total weighted score. The next best performing option was MBT RDF with a total weighted score of 148, and 69% of the total weighted score. The lowest performing technology option was Autoclave with a weighted score of 133.

The difference between EfW and EfW CHP score is marginal. Where possible BCC should seek to exploit the additional benefits of EfW CHP, however they need to understand the possible off-take risks and practical deliverability issues associated with this option.

3.5 WRATE GHG Emissions

WRATE GHG emissions:

The Greenhouse Gas emissions are calculated using WRATE. Below are the emissions of Greenhouse gases expressed as kilogram equivalents of carbon dioxide and the associated

scores for the options. These values were used by Grant Thornton in the evaluation of the Shadow Price of Carbon.

Option	tonnes CO2 eq	NPV of the Shadow Price of Carbon
EfW	-3,183	-£1,097,445
EfW CHP	-28,924	-£9,973,521
ATT	5,269	£1,816,993
MBT RDF to EfW	-9,529	-£3,285,856
Autoclave & RDF to EfW	-40,962	-£14,124,713

3.6 Financial Analysis

Financial modelling was completed by Grant Thornton LLP and has been reported separately.

The results of the financial assessment are provided below together with the total net present value of costs including the shadow price of carbon.

Option	NPV of Costs	Total NPV including SPC
EfW	£196,650,676	£195,553,230
EfW CHP	£196,650,676	£186,677,154
ATT	£283,592,491	£285,409,485
MBT RDF to EfW	£283,379,203	£280,093,347
Autoclave & RDF to EfW	£314,371,288	£300,246,575

4. Evaluation Results

4.1.1 Marking Methodology

Once the scoring exercise was complete the scores were translated into marks. The BCC Project Board agreed a weight between technical and financial of:

Technical	40%
Financial	60%

4.1.2 Technical Marks

The technical score therefore has to be translated into marks out of 40, where 40 marks are allocated to the best performing options technically. The formula used was:

40 x (option score/highest option score)

Table 4.1 Technical Scores and Marks for Options

Option	Weighted Score	Marks
EfW	166	40
EfW CHP	161	38.8
ATT	142	34.2
MBT RDF to EfW	148	35.7
Autoclave & RDF to EfW	133	32.0

4.1.3 Financial Marks

The financial costs of each option have to be translated into marks out of 60, where 60 marks are allocated to the best performing options.

The formula used was:

60 x (lowest option cost/ option cost)

Table 4.2 presents the financial costs including SPC of each option as calculated by Grant Thornton LLP.

Table 4.2 Financial Scores and Marks for Options

Option	£ (Inc SPC)	Marks
EfW	195,553,230	57
EfW CHP	186,677,154	60
ATT	285,409,485	39
MBT RDF to EfW	280,093,347	40
Autoclave & RDF to EfW	300,246,575	37

4.1.4 Combined Marks

The combined marks are presented in Table 4.3.

Table 4.3 Combined technical and financial Marks for Options

Option	Technical Marks	Financial Marks	Total Marks
EfW	40	57	97.0
EfW CHP	38.8	60	98.8
ATT	34.2	39	73.2
MBT RDF to EfW	35.7	40	75.7
Autoclave & RDF to EfW	32.0	37	69.0

5. Conclusion

The highest scoring option in this Options Appraisal is EfW with CHP with 98.8 marks. EfW is the second highest scoring option with 97 marks. Only 1.8 marks separate the top two scoring options. The third highest scoring option is MBT producing an RDF which is treated in an EfW. There is over a 21 point difference between the MBT option and the EfW option. Only 5 marks separate the bottom three options.

It should be noted that if the overall weighting between Finance and Technology (40/60) was changed to 50/50 or even 60/40, the number one solution would not change.

Given the weightings and scores applied to the evaluation criteria, the highest scoring option for BCC is EfW with CHP. As detailed previously, BCC should seek to exploit the additional benefits of EfW CHP provide, but should be aware of the possible off-take risks and practical deliverability issues associated with this option.