

Appendix 4.b

Options Appraisal

The options appraisal report was created by The Partner's external technical advisors Entec. This is appended below.

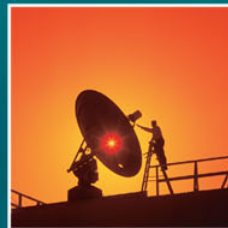
Project Transform

Residual Waste Treatment Procurement

OBC Option Appraisal

October 2008

Entec UK Limited



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Report for

Kalen Wood
Programme Manager - Waste Procurement Manager
Warwickshire County Council
County Hall
Warwick

Main Contributors

Alex Green
Chris Hudson

Issued by

.....
Alex Green

Approved by

.....
Ken Rigby

Entec UK Limited

Windsor House
Gadbrook Business Centre
Gadbrook Road
Northwich
Cheshire
CW9 7TN
England
Tel: +44 (0) 1606 354800
Fax: +44 (0) 1606 354810

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1. Scenarios for Residual Waste Management

1.1 Development of Strategic Scenarios

1.1.1 Strategic Context

Project Transform successfully submitted an Expression of Interest (EoI) for PFI credits for a residual waste management procurement. The EoI is based on the Project Transform partnership strategy which is drawn from the individual strategies of Coventry City Council (CCC), Solihull Metropolitan Borough Council (SMBC), and Warwickshire County Council (WCC).

The strategy identified the need for replacement residual waste treatment facilities in the medium term to meet statutory targets and ensure compliance with the EU Landfill Directive.

As part of the EOI, an initial options appraisal looked at all the possible waste management strategies open to the Project. From this options appraisal, a reference case of Energy from Waste was selected from the EoI. The EoI option appraisal however did not include a full environmental analysis, nor any economic analysis of the options.

The output from the EoI option appraisal therefore requires refining in order to select a suitable reference case for the next stage of the PFI process, which is the submission of the Outline Business Case (OBC).

1.1.2 Need for Reference Project

A critical stage in the development of a business case is the identification and appraisal of a range of scenarios that will deliver the service changes and efficiency improvements required. Best value is achieved by a thorough and robust comparison of the various Scenarios available, leading to the selection of a Reference Project, against which bids will subsequently be evaluated. Therefore, the Reference Project is a solution which satisfies the aims and objectives of Project Transform, rather than a specification for future delivery of the service.

The Reference Project is not necessarily the solution which will be delivered by the procurement.

1.1.3 Scenarios Evaluation – ‘Green Book’ Guidance

All new policies, programmes and projects, whether revenue, capital or regulatory, should be subject to comprehensive but proportionate assessment, wherever it is practicable, so as best to promote the public interest. The Green Book¹ presents the techniques and issues that should be considered when carrying out assessments. This guidance is designed to promote efficient policy development and resource allocation across government. It does this by informing decision-making, and by improving the alignment of departmental and agency policies, programmes and projects with government priorities and the expectations of the public. The guidance emphasises

¹ HM Treasury Green Book (Updated 2003): ‘Appraisal and Evaluation in Central Government’



the need to take account of the wider social costs and benefits of proposals, and the need to ensure the proper use of public resources.

'The Green Book describes how the economic, financial, social and environmental assessments of a policy, programme or project should be combined'.

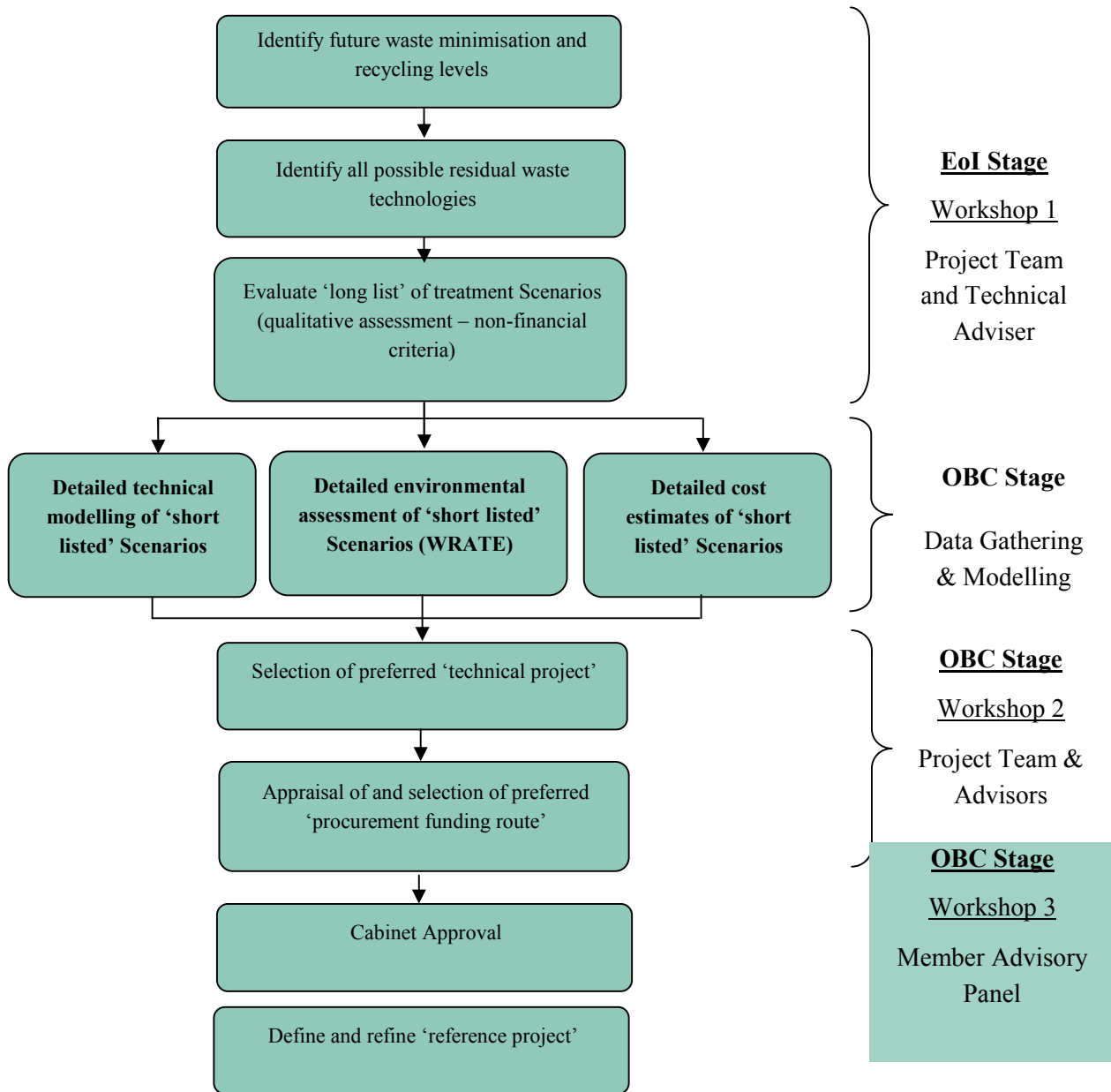
Appraisals should provide an assessment of whether a proposal is worthwhile, and clearly communicate conclusions and recommendations. The essential technique is Scenario appraisal, whereby intervention is validated, objectives are set, and Scenarios are created and reviewed, by analysing their costs and benefits. Within this framework, cost-benefit analysis is recommended, as contrasted with cost-effectiveness analysis, with supplementary techniques to be used for weighing up those costs and benefits that remain unvalued.

1.2 **Project Transform Scenarios Appraisal**

The process used to evaluate potential Scenarios and develop a reference project followed the guidance outlined in the HM Treasury Green book. The complete process involves a number of interactive workshops involving the project team which comprised representatives of Project Transform, corporate finance and financial and technical advisors. Figure 1.1 illustrates the process adopted in defining the reference project.



Figure 1.1 Scenarios Appraisal Process



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2. EoI Appraisal

2.1 Long List Appraisal

The appraisal process started at the EoI phase of the project when the project team and their advisers developed a long-list of potential residual waste treatment scenarios.

This long list considered an extensive list of options, covering differing recycling and composting rates, a wide spread of residual waste management techniques, and differing approach to landfill.

The long list was then reviewed to confirm which of the options met the general strategy of Project Transform, creating a short-list of 11 technical scenarios

2.2 Short List Appraisal

The 11 technical scenarios produced from the long-list appraisal were considered and assessed. Apart from scenario one, all of the scenarios assumed that 50% recycling and composting would be achieved and that LATs targets are met. The following table provides a summary of the scenarios that were assessed as part of the long-listing process to select the reference case for the EoI, and to form a further a short-list of options for detail examination and assessment as part of the development of the OBC.

Key to Abbreviations

- RDF – Refuse Derived Fuel
- SRF – Secondary Recovered Fuel
- MBT – Mechanical Biological Treatment
- ATT – Advanced Thermal Treatment
- LATS – Landfill Allowance Trading Scheme



Table 2.1 Short-list Options

Option Number	A Waste Minimisation	B Recycling and Composting	C Residual Waste to Landfill	Scenario Summary Description
1	Current levels	Current levels	Current levels	Maintain Current Recycling Level - Landfill - Landfill
2	Maximise	50%	Meet LATS	High Recycling - RDF/RDF MBT - RDF to 3rd party burner
3	Maximise	50%	Meet LATS	High Recycling - RDF/RDF MBT - RDF to purpose built burner
4	Maximise	50%	Meet LATS	High Recycling - Bio-stabilise MBT - Residue to landfill
5	Maximise	50%	Meet LATS	High Recycling - MBT AD - RDF Energy Recovery
6	Maximise	50%	Meet LATS	High Recycling - Autoclave - Thermal treatment
7	Maximise	50%	Meet LATS	High Recycling - EfW - Meets LATS allowance
8	Maximise	50%	Minimise Landfill	High Recycling - EfW - Max Residual to EfW to minimise landfill
9	Maximise	50%	Meet LATS	High Recycling - ATT - Meets LATS allowance
10	Maximise	50%	Minimise Landfill	High Recycling - ATT - Max Residual to facility to minimise landfill
11	Maximise	50%	Meet LATS	High Recycling - RDF/RDF MBT - RDF to Cement Kiln

2.3 EoI Ranking

The options assessment of the EoI shortlist produced the ranking listed in table 2.2 below:

Table 2.2 EoI Ranking

Ranking	Option	Scenario Summary Description
1	8	High Recycling - EfW - Max Residual to EfW to minimise landfill
2	7	High Recycling - EfW - Meets LATS allowance
3	10	High Recycling - ATT - Max Residual to facility to minimise landfill
4	3	High Recycling - RDF/RDF MBT - RDF to purpose built burner
5	5	High Recycling - MBT AD - RDF Energy Recovery
6	2	High Recycling - RDF/RDF MBT - RDF to 3rd party burner
7	9	High Recycling - ATT - Meets LATS allowance
8	6	High Recycling - Autoclave - Thermal treatment
8	11	High Recycling - RDF/RDF MBT - RDF to Cement Kiln
10	4	High Recycling - Bio-stabilise MBT - Residue to landfill
11	1	Maintain Current Recycling Level - Landfill - Landfill



Scenario 8, high recycling with an EFW to minimise landfill was selected as the reference project for the EoI.

The top six ranked scenario, plus scenario 1 as a “do nothing” option were taken forwards for further consideration as part of the OBC.



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3. OBC Appraisal

3.1 Short-listed options

The results from the EoI gave seven scenarios for further consideration.

These are shown in table 3.1 below.

Table 3.1 Short-listed Options for Further Assessment

Option Number	A Waste Minimisation	B Recycling and Composting	C Residual Waste to Landfill	Scenario Summary Description
1	Current levels	Current levels	Current levels	Maintain Current Recycling Level - Landfill - Landfill
2a	Maximise	50%	Minimise landfill	High Recycling – EfW – Maximum residual to EfW to minimise landfill
2b	Maximise	50%	Minimise landfill	High Recycling – EfW with CHP Maximum residual to EfW to minimise landfill
3	Maximise	50%	Meets LATS	High Recycling - EfW - Meets LATS allowance
4	Maximise	50%	Minimise landfill	High Recycling – ATT – Maximum residual waste to facility to minimise landfill
5a	Maximise	50%	Meets LATS	High Recycling - RDF/SRF MBT – RDF to purpose built burner
5b	Maximise	50%	Meets LATS	High Recycling - RDF/SRF MBT to a purpose built burner with CHP
6	Maximise	50%	Meet LATS	High Recycling - MBT AD - RDF Energy Recovery
7	Maximise	50%	Meet LATS	High Recycling - RDF/RDF MBT - RDF to 3rd party burner

To improve the assessment, options 2 and 5 were considered with two variants – the first where the energy recovery plant operates in an electricity generation mode only (options 2a and 5a), and the second where the energy recovery plant operates in CHP mode, with both electricity and heat export (options 2b and 5b).

Detailed waste flow models of each of these residual waste treatment options were developed, along with full environmental impacts and provisional financial impact of the whole-life costs. The environmental assessment was analysed using the WRATE tool (Waste and Resources Assessment Tool for the Environment), which assess the environmental impact of waste treatment technologies. The financial impact was reviewed using Defra Full Economic cost guidance.

The full waste models, environmental impact, and financial impacts of each option was then reviewed at a second options appraisal workshop. This workshop developed further assessment criteria, determined



weightings for the criteria, then scored each of the options in turn. This led to the selection of a preferred reference case for the OBC.

3.2 Assessment Criteria and Weightings

3.2.1 Main Criteria

For the purpose of the options appraisal, the project team, supported by their advisers were asked to agree weightings for criteria that would be applied to the assessment of each option. The agreed weightings are provided in the following table.

Table 3.2 Weightings agreed by Project Transform Project Team

Main Criteria	Weighting %	Comments
Technical	40	
Environmental	20	
Economic	40	
Social	0	Included in Environmental
Other, e.g. Fit with Waste Strategy	0	Included in Technical
Total	100	

This balanced weighting represented the workshop view that none of the main criteria should be allowed to dominate the project process, i.e. the decision could not be all on cost, or all on technical issues, as a balanced view was required to find a realistic reference project which would be affordable, have a good track record, transfer risks from the Project Transform Authorities, and have a low environmental impact.

The criteria “social” was thought to duplicate the aspects to be reviewed within environmental, which would look at the impacts on the local communities around the new facility.

The criteria “other” was thought to be a little vague, although specific items such as fit with waste strategy would form part of the technical evaluation.

It was agreed that the weightings selected at this stage would be subjected to a sensitivity analysis to ensure that the results were not dominated by these specific weightings.



3.2.2 Sub Criteria

The content of each of the main criteria was then considered, and a table of specific sub-criteria developed. These sub-criteria were discussed in terms of how they could be assessed, and how they could be used to differentiate between possible solutions.

Weightings were then allocated to each of the sub-criteria.

The complete list of sub-criteria and their weightings is listed in table 3.3 below.

Table 3.3 Scenarios Appraisal Evaluation Criteria and Weighting

Primary Evaluation Criteria	Weighting of Primary Criteria	Secondary Evaluation Criteria	Method Used for Evaluation	Weighting of Secondary Criteria (as % of primary criteria)
Technical	40%	'Track record' of technology	Prof Judgement	25%
		CHP / SRF usage	Prof Judgement	15%
		Flexibility and adaptability of solution	Prof Judgement	18%
		LATS Position / certainty	Mass Flow Model / Prof Judge.	5%
		Operational fit (WCA interface, transport)	Prof Judgement	5%
		Strategic Fit	Prof Judgement	15%
		Availability of Markets / outlets	Prof Judgement	10%
		Material Recycled/Composted BVPI's	Mass Flow Model	7%
Environmental / Social	20%	Abiotic Resource Depletion	From WRATE	8%
		Freshwater aquatic ecotoxicity	From WRATE	8%
		Acidification	From WRATE	8%
		Eutrophication	From WRATE	8%
		Global warming potential	From WRATE	25%
		Human Toxicity	From WRATE	20%
		Local Amenity (odour, visual impact, noise)	Prof. Judge	15%
		Public Opposition / Support	Prof Judgement	10%
Economic	40%	FEC (including attractiveness to PFI)	NPV of Solution.	50%
		Risk Transfer / bankability	Prof Judgement	20%
		Exposure to financial risk (LATS/Landfill Tax)	Prof Judgement	30%



The decisions on applying the weightings were based on discussions at the workshop in terms of what would constitute a realistic and deliverable project.



4. Options Appraisal Scoring

4.1 Scoring

The next stage of the process was for the project team to score each option against the agreed sub-criteria. A score out of 5 was given for each sub-criteria, where 1 represented an area where the scenario was poor, with potential problems matching the, through to 5, which represented an area where the scenario was good, with only minor issues expected in matching the strategy in this criteria.

4.2 Technical Sub-Criteria

4.2.1 Track Record

The track record of waste treatment technologies was scored on the current situation of waste treatment in the UK, Europe and overseas. Technologies with a good proven track record in the UK scored highest. Technologies with proven track records outside of the UK also scored well, but were slightly lower than those with a long UK history.

The technologies that scored well for this criterion include EfW and landfill as these technologies have the longest history in the UK and boast the most operational facilities. The MBT Scenarios scored slightly less as there is limited track record in this country.

4.2.2 CHP / SRF Usage

Achieving good energy use from the residual waste is considered a key strategic aspect, and will influence the success of planning applications for the facilities. Options which include CHP directly, or generate a SRF for potential use within CHP schemes scored better than scenarios without heat capture.

4.2.3 Flexibility and Adaptability of Solution

The expected technical solution will be a long term infrastructure development. The changing environment of waste management suggests that the composition and quantity of waste will inevitably change over the course of the contract period. Therefore, the solution procured must be able to adapt to variations in input compositions, tonnages and output configurations.

Solutions which deal with the entire waste stream will meet this key risk; Where a secondary material is produced (RDF) for export to third party facilities, there is an increased risk that the required specifications will not be met, resulting in greater waste going to landfill.



4.2.4 LATS Position / Certainty

Mass flow modelling undertaken for all scenarios looks at the future waste flows for the expected period of the procurement contract. This includes review against the EU landfill directive targets for the diversion of biodegradable municipal waste away from landfill. The UK LATS regime has allocated tradable allowances to each WDA in England up to 2020.

The assessment of this indicator reviewed the expected extent of meeting LATS, or the benefits from exceeding LATS targets. The scenario which just meets LATS was considered as the worst position, as this has larger quantities of landfill from both Coventry and Solihull than at present. The two EFW options with a minimum landfill position were considered the most likely to achieve the targets. MBT based solutions could have some potential difficulties in disposal of segregated outputs, or onward sales of RDF / digestate, and therefore scored less well.

4.2.5 Operational Fit (WCA interface, transport)

The criterion of 'operational fit' was primarily concerned with the impact a new facility or facilities would have on the waste collection authority partners. With a preference for development on the same / adjacent site, all the scenarios were considered to have the same ranking.

4.2.6 Strategic Fit

The scoring for this evaluation criterion was based on how well the solution delivers the three waste management strategies. All three strategies look to a partnership based approach with a single main residual waste treatment facility, minimising landfill, and capturing as much energy potential as possible. Accordingly the EFW and MBT scenarios with CHP are the best strategic fit.

4.2.7 Availability of Markets / Outlets

Some of the processes modelled are dependant on the availability of downstream markets to ensure a viable solution. Outputs from MBT technologies require outlets for the low grade recyclable material, the biostabilisation MBT's need outlets for the compost like product to reduce the reliance on landfill for disposal. The EFW solutions will require outlets for the bottom ash if this is to be re-used, however this is a relatively mature market and a 2003 study by the Chartered Institute of Waste Management (CIWM) suggested the approximately 42% incinerator bottom ash is currently re-used.

MBT scenarios with third party use of RDF are also reliant on external markets, with the UK RDF market currently considered immature.

4.2.8 Material Recycled/Composted BVPI's

Whilst the project partners have all undertaken to achieve the statutory recycling and composting targets from direct action, and therefore are not reliant on the residual waste treatment facility delivering any additional



recycling or composting, it was recognised that the MBT based technologies are likely to contribute additional recycling. Accordingly, the MBT technologies scored better than the EFW.

All scenarios meet the strategy targets of achieving 50% recycling and composting.

4.2.9 Technical Scores

Table 4.1 records the overall scores for each sub-criteria.

Table 4.1 Technical Score Summary

	"do nothing"	EFW	EFW_C HP	EFW_L ATS	ATT	MBT_R DF	MBT_R DF_CH P	MBT/A Dthere _RDF	MBT/A D_tpRDF
	1	2a	2b	3	4	5a	5b	6	7
'track record' of technology	4	5	5	5	2	3	3	3	2
CHP / SRF usage	1	3	5	2	3	3	5	3	4
Flexibility and adaptability of solution	5	4	4	4	2	4	4	3	3
LATS Position / certainty	1	5	5	3	4	4	4	4	4
Operational fit (WCA interface, transport)	3	3	3	3	3	3	3	3	3
Strategic Fit	1	4	5	3	4	4	5	4	4
Availability of Markets / outlets	1	4	3	4	4	4	3	2	2
Material Recycled/Composted BVPI's	1	2	2	2	2	3	3	3	3

4.3 Environmental Criteria Scoring

4.3.1 WRATE Lifecycle Analysis and Environmental Impact Assessment

The Waste Resources Assessment Toolkit for the Environment (WRATE) has been developed by the Environment Agency (EA) to enable local authorities to model the potential effects of current and future waste services on the environment. This enables authorities to consider the whole life benefits (or costs) of utilising different technologies and introducing new collection services and supports them in the decision making process. As a lifecycle analysis tool WRATE considers the impact of municipal waste from the point of collection through to either the point of final disposal or the point whereby the waste has been processed into a material available for use again within the materials chain.



WRATE includes significant data on current operational facilities for the treatment of the residual waste stream, including the site process data collected by the EA’s Waste Technologies Data Centre (WTDC). This includes the processes environmental costs and benefits of resources used, transport and the operational impacts of materials, and energy treated downstream from treatment processes. The modelling of potential residual waste treatment Scenarios is based on currently available facilities.

WRATE includes default ratios of the various elements within the electricity generating mix for both the UK and for England up to 2020 to take account of the range of fuels used for electricity generation.

Default data from the waste flow models was used to define the WRATE waste composition.

Each of the scenarios was modelled using the WRATE software as shown in Table 6.1.

Table 4.2 Scenarios Modelling Summary

Scenario	Description	Front End Recycling	Residual Treatment
Scenario 1	Maintain Current Recycling Level - Landfill - Landfill	50%	Existing EFW, then landfill
Scenario 2 a	High Recycling – EFW – Maximum residual to EFW to minimise landfill	50%	Modern EFW, based on Chineham EFW
Scenario 2 b	High Recycling – EFW with CHP Maximum residual to EFW to minimise landfill	50%	Modern EFW with CHP, based on Sheffield EFW-CHP
Scenario 3	High Recycling - EFW - Meets LATS allowance	50%	Modern EFW, based on Chineham EFW
Scenario 4	High Recycling – ATT – Maximum residual waste to facility to minimise landfill	50%	Based on Energos gasification process
Scenario 5 a	High Recycling - RDF/SRF MBT – RDF to purpose built burner	50%	Based on Ecodeco process, then modern EFW, based on Chineham EFW
Scenario 5 b	High Recycling - RDF/SRF MBT to a purpose built burner with CHP	50%	Based on Ecodeco process, then modern EFW with CHP, based on Sheffield EFW-CHP
Scenario 6	High Recycling - MBT AD - RDF Energy Recovery	50%	Based on Haase AD process, then modern EFW, based on Chineham EFW
Scenario 7	High Recycling - RDF/RDF MBT - RDF to 3rd party burner	50%	Based on Haase AD process, then modern EFW, based on Chineham EFW

4.3.2 WRATE Scoring

The results for each category were plotted for each scenario. The scores were then allocated in bands, with the best performing in each category scoring 5, the worst performing scoring 1 for each category.

This assists the overall evaluation by allowing the relative ranking of each of the scenarios against the other options.

The “banding” approach also takes account that the chosen and modelled technology within WRATE may not completely replicate the actual performance of a market response, for example, the MBT process may not actually be an Ecodeco process, but another similar style of process.



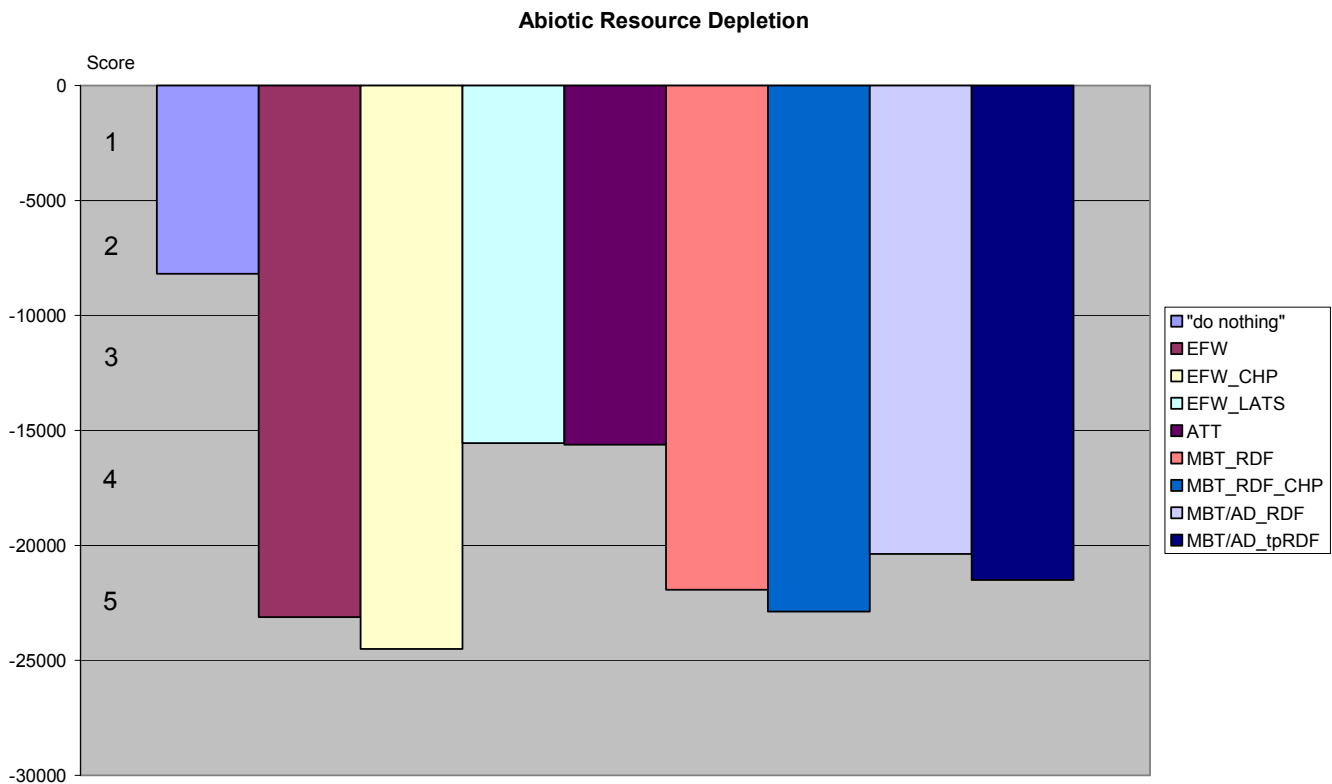
The scores for each WRATE criteria are shown adjacent to the left hand vertical axis on each graph.

4.3.3 Abiotic Resource Depletion

The Abiotic Resource Depletion (kg antimony equivalent) can be defined as the use of (and therefore decreasing the availability of) non-renewable and renewable resources. Abiotic resources are non-living things, including land, water, air and minerals.

Figure 4.1 presents the modelled results for Abiotic Resource Depletion. A negative result denotes an ‘avoided burden’ (e.g. a process has a beneficial impact) while a positive results denotes a detrimental impact.

Figure 4.1 WRATE Results for Abiotic Resource Depletion



4.3.4 Global Warming Potential

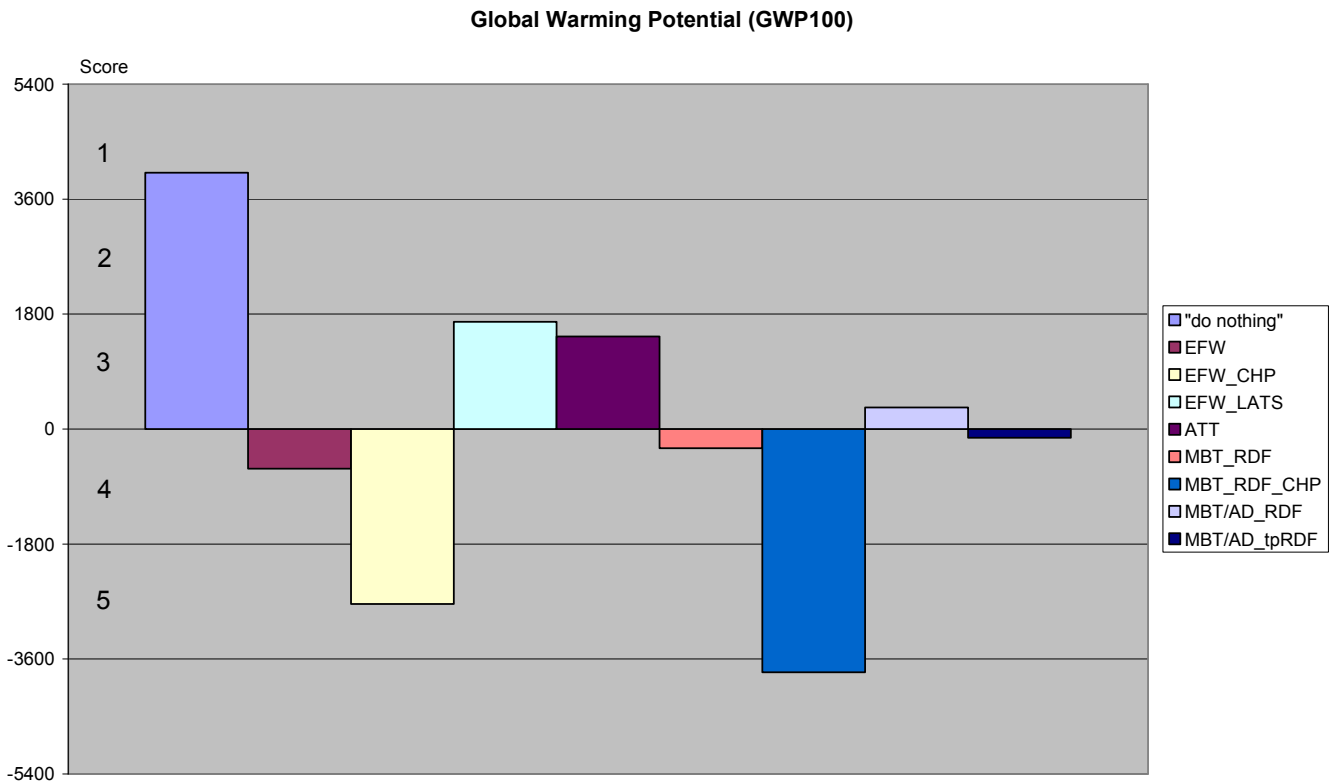
Global Warming Potential is measured in kg of carbon dioxide equivalent. Global warming is the phenomenon of increases in temperature of the earth’s surface. Incoming solar radiation is absorbed by the earth and reflects back towards the atmosphere at longer wavelengths. Certain gases (principally carbon dioxide, water vapour, methane and chlorofluorocarbons) exhibit properties that in turn absorb this reflected radiation and elevate the temperatures of the lower atmosphere. The concentration of these so-called green house gases is believed to influence the effectiveness of the phenomenon and, hence, the steady state temperature of the earth. This indicator in the



WRATE software is a measure of what mass of greenhouse gases are estimated to contribute to global warming, a relative scale that compares emissions to Carbon Dioxide.

Figure 4.2 presents the results from the WRATE analysis for Global Warming Potential. A positive number represents a net impact, with a negative number a net benefit.

Figure 4.2 WRATE Results for Global Warming Potential



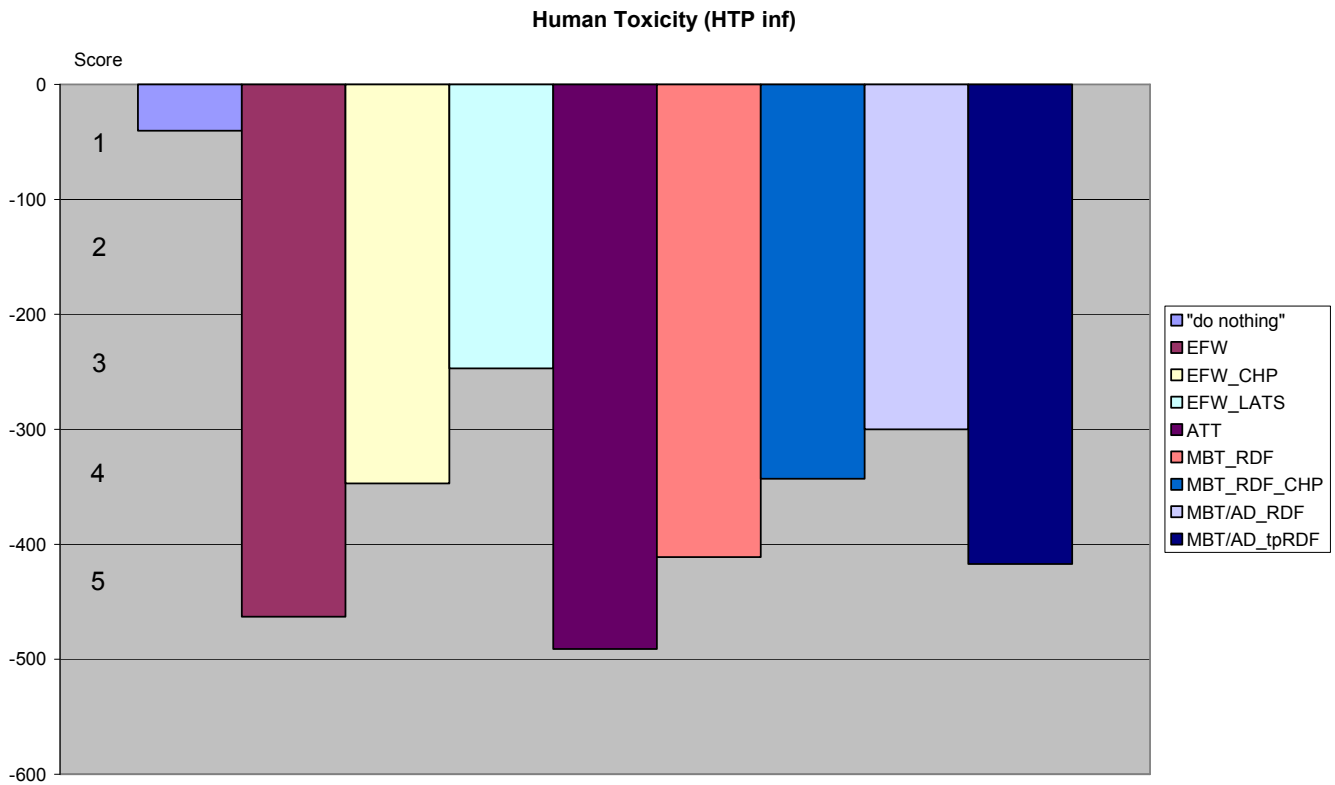
4.3.5 Human Toxicity

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 emission to different compartments: air, water, and soil and exposure via different media: air water, and soil.

Figure 4.3 presents the results from the WRATE analysis for Human Ecotoxicity. A positive number represents a net impact, with a negative number a net benefit.



Figure 4.3 WRATE Results for Human Toxicity



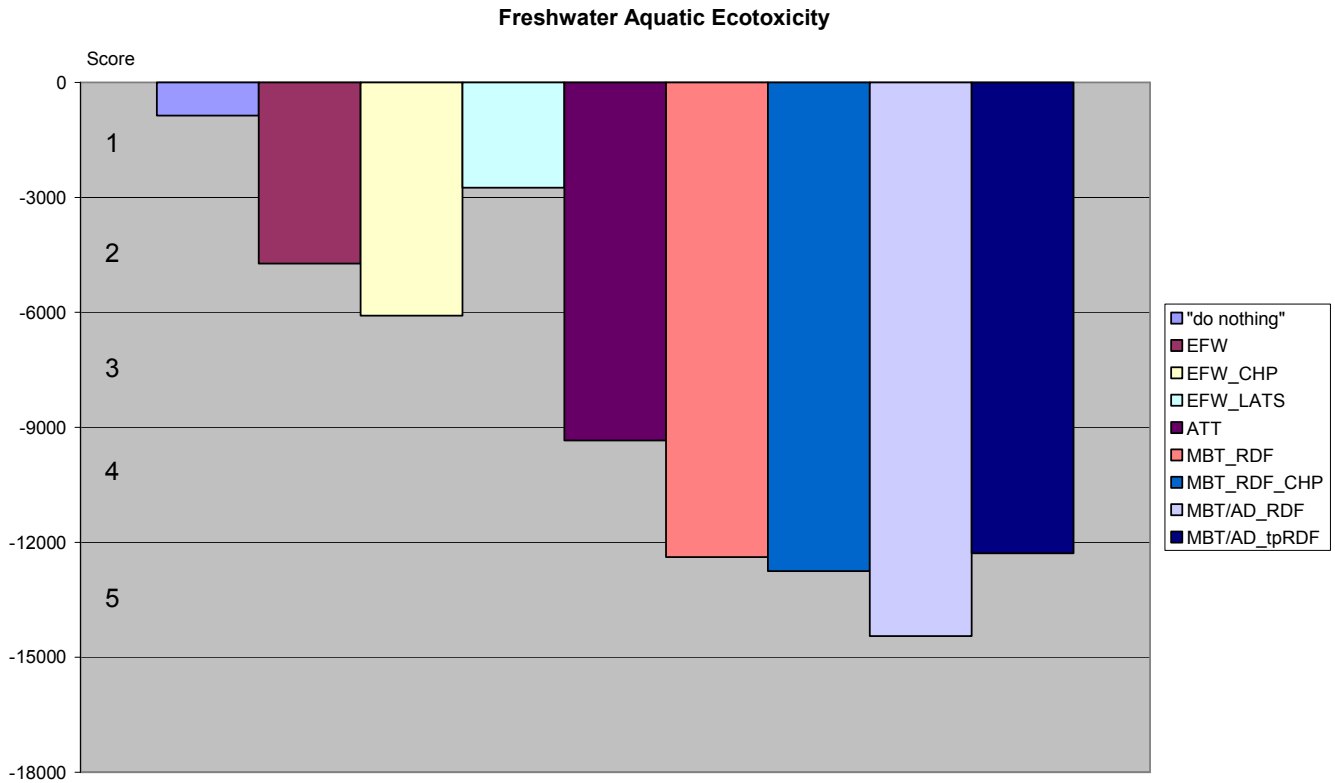
4.3.6 Freshwater Aquatic Ecotoxicity

Freshwater Aquatic Ecotoxicity, measured in kg of 1,4-dichlorobenze equivalent, is the level of toxicity expected in freshwater resulting from a proposed process. Toxicity towards ecosystems can be regarded as either chronic (causing long lasting illness) or acute (short term/ immediate effects).

Figure 4.4 presents the results from the WRATE analysis for Freshwater Aquatic Ecotoxicity. A positive number represents a net impact, with a negative number a net benefit.



Figure 4.4 WRATE Results for Freshwater Aquatic Ecotoxicity



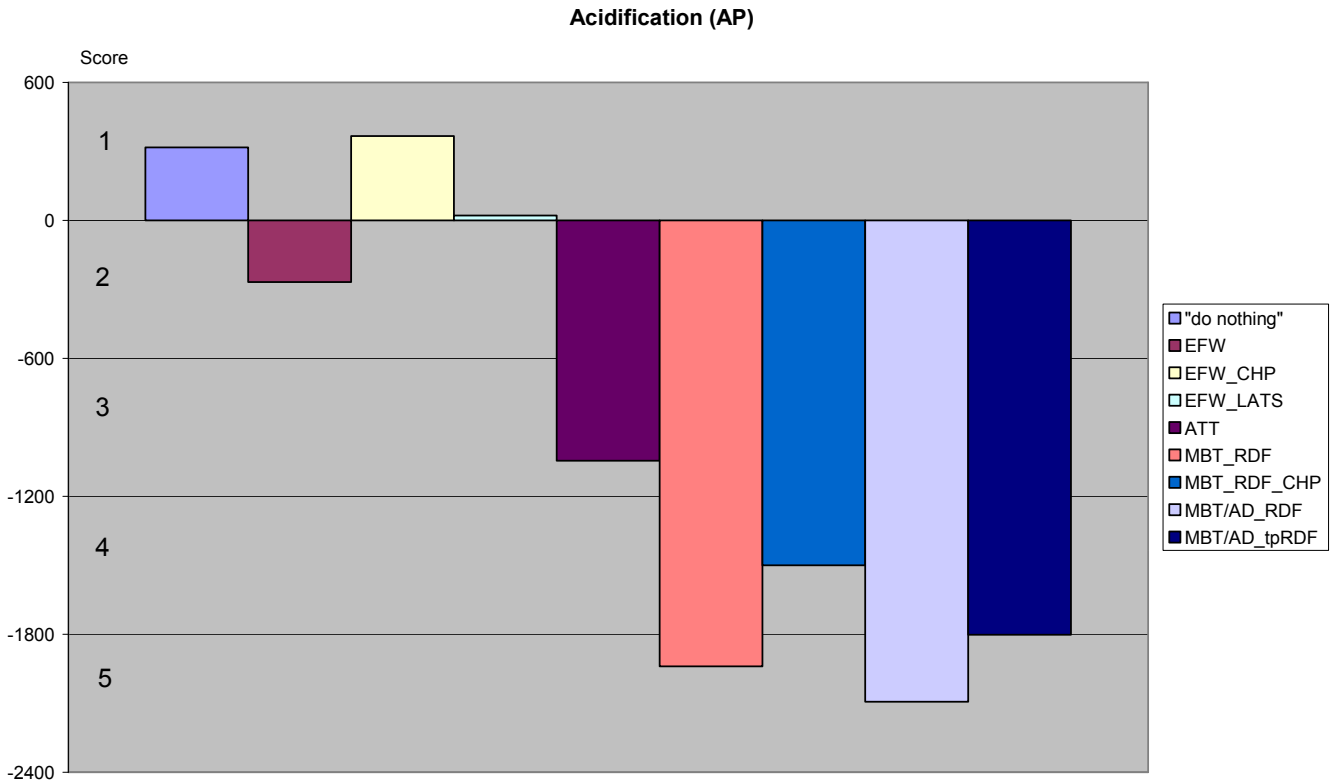
4.3.7 Acidification

Acidification, measured in kg of sulphur dioxide equivalent, is an indicator measuring the emissions of acidifying compounds such as sulphur dioxide and nitrous oxides. Acidifying compounds in a gaseous state may either be dissolved in water or fixed in solid particles. They reach ecosystems through dissolution in rain or by wet deposition. These compounds attack leaves and acidify the soil which can result to changes in the ecosystem.

Figure 4.5 presents the results from the WRATE analysis for Acidification. A positive number represents a net impact, with a negative number a net benefit. The larger the negative number, larger the net benefit of a solution.



Figure 4.5 WRATE Results for Acidification



4.3.8 Eutrophication

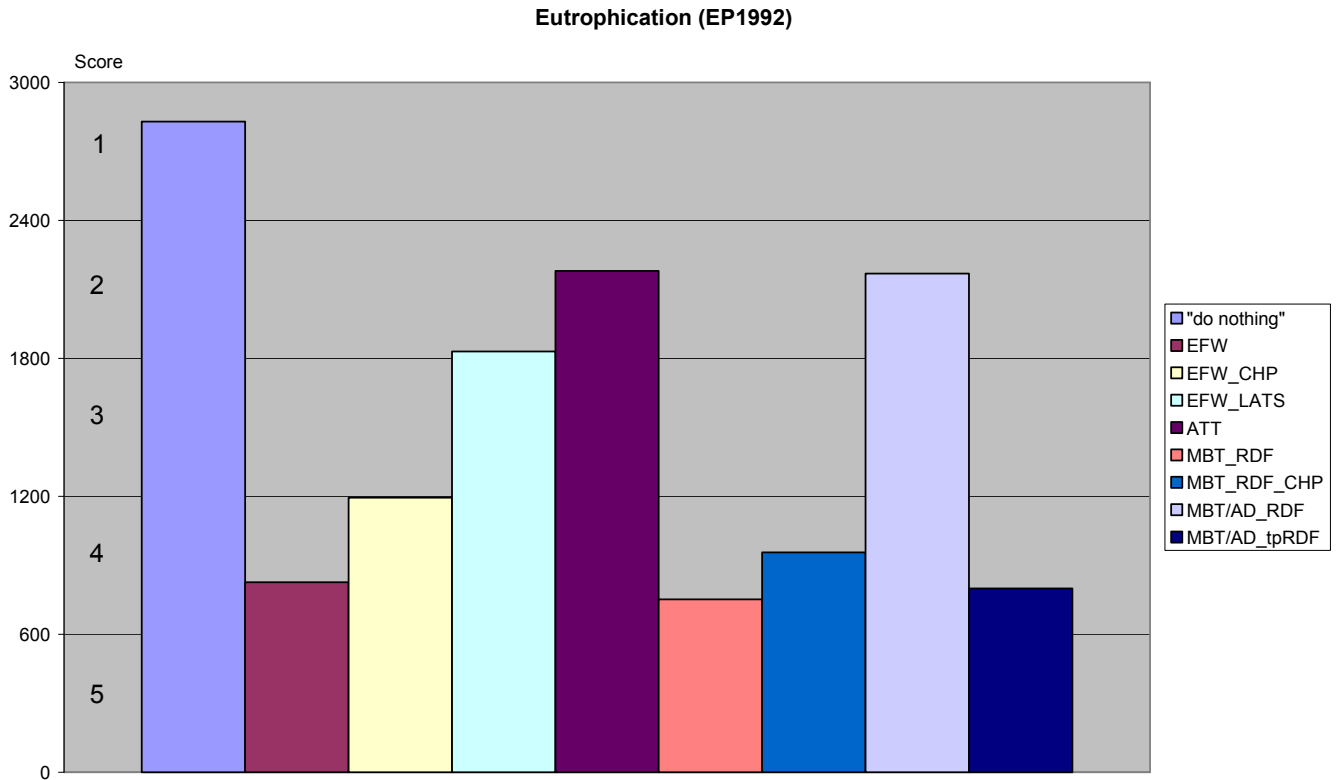
Eutrophication, measured in tonnes of Phosphate equivalent, is caused by the increase of chemical nutrients, typically compounds containing nitrogen phosphorus. It is a form of water pollution and is defined either as the enrichment in mineral salts of marine or lake waters when it refers to the natural process, or as the enrichment in nutritive elements of waters when referring to human intervention.

Eutrophication is primarily a natural process; mineral salts brought by erosion increase lake biomass, hence biomass sedimentation and erosion lead to filling of the lake. However, human activities have dramatically accelerated eutrophication by releasing phosphorous compounds (e.g. fertilisers, detergents etc), nitrogen compounds (fertilisers) and organic matter (urban and industrial effluents) into watercourses.

Figure 4.6 presents the results from the WRATE analysis for Eutrophication. A positive number represents a net impact, with a negative number a net benefit.



Figure 4.6 WRATE Results for Acidification Eutrophication



4.3.9 Summary of WRATE Results

Table 4.3 below gives the overall scores and WRATE outputs for each option.



Table 4.3 WRATE Results for Each Option

		"do nothing"	EFW	EFW_CHP	EFW_LATS	ATT	MBT_RDF	MBT_RDF_CHP	MBT/A Dthere_RDF	MBT/A D_tpRDF
		1	2a	2b	3	4	5a	5b	6	7
Abiotic Resource Depletion	te antimony eq.	-320	-900	-950	-600	-610	-850	-890	-790	-830
	score	2	5	5	3	3	5	5	4	5
Global Warming (GWP100)	te CO2 eq.	50490	-7790	-34460	21120	18250	-3760	-47890	4250	-1730
	score	1	3	4	2	2	3	5	2	3
Human Toxicity (HTP inf.)	te 1,4-dichlorobenzene eq.	-800	-9150	-6860	-4890	-9700	-8120	-6770	-5930	-8240
	score	1	5	4	3	5	5	4	4	5
Freshwater Aquatic Ecotoxicity (FAETP inf.)	te 1,4-dichlorobenzene eq.	-1140	-6230	-8020	-3620	-12310	-16320	-16800	-19040	-16190
	score	1	2	3	1	4	5	5	5	5
Acidification (AP)	te SO2 eq.	20	-20	30	0	-70	-140	-110	-150	-130
	score	1	2	1	1	4	5	4	5	4
Eutrophication (EP1992)	te PO4--- eq.	90	30	40	60	70	20	30	70	30
	score	1	4	4	2	2	4	4	2	4

Whilst the model is sensitive to the choice of residual waste technology type (e.g. MBT versus EfW), and particularly to the specific technology manufacturer, the results can be considered to indicate the relative ranking and impact of each scenario.

The most influential criteria appear to be the addition of CHP, which is noted in the improved Global Warming performance of both options 2a moving to 2b, and 5a moving to 5b. A similar improvement in both results was anticipated, however, there was a larger change in the results from 5a to 5b. This appears to be a result of the embedded process technologies within the WRATE model. The only difference expected between the scenarios was the ability to bleed steam from the steam turbine stage of an identical process, and export this steam.

4.3.10 Local Amenity and Public Opposition / Support

Local amenity was considered to be the local impacts of odour, noise and vibration, visual intrusion and traffic impacts. The main issues considered were that the local community is familiar with EFW facilities, and that a replacement EFW would not be a “change from the current norm”. MBT was judged less favourably due to the significant land take, and for schemes exporting RDF, as contrary to local strategic principles of dealing with local waste.



Public opposition / support considered how the local community would react to each development. In general terms, a vocal opposition was anticipated for EFW facilities, with a public preference for MBT solutions, with all solutions encompassing CHP scoring better than without.

Table 4.5 below gives the overall scores for Local Amenity and Public Opposition / Support.

Table 4.4 Local Amenity and Public Opposition/Support scores

	"do nothing"	EFW	EFW_CHP	EFW_LATS	ATT	MBT_RDF	MBT_RDF_HP	MBT/A Dthere_RDF	MBT/A D_tpRDF
	1	2a	2b	3	4	5a	5b	6	7
Local Amenity	1	4	4	4	3	3	3	3	2
Public Opposition / Support	1	2	3	2	2	3	4	3	4

4.4 Financial Criteria Scoring

4.4.1 Full Economic Cost of Solution

The Defra Options Appraisal Guidance gives a clear and concise approach to establishing a value of the carbon impact of each option, and requires OBC option appraisals to consider the full economic cost of each solution (FEC). The FEC includes a Shadow Price of Carbon calculated from the WRATE CO₂ output from each solution for the year when the full waste management system is operational. The WRATE CO₂ output for each solution is shown in table4.3 below.

Table 4.5 WRATE CO2 Output

Scenario	Description	teCO ₂ / te treated
Scenario 1	Maintain Current Recycling Level - Landfill - Landfill	0.12761
Scenario 2 a	High Recycling – EFW – Maximum residual to EFW to minimise landfill	-0.01969
Scenario 2 b	High Recycling – EFW with CHP Maximum residual to EFW to minimise landfill	-0.0871
Scenario 3	High Recycling - EFW - Meets LATS allowance	0.053379
Scenario 4	High Recycling – ATT – Maximum residual waste to facility to minimise landfill	0.021584
Scenario 5 a	High Recycling - RDF/SRF MBT – RDF to purpose built burner	0.046126
Scenario 5 b	High Recycling - RDF/SRF MBT to a purpose built burner with CHP	-0.0095
Scenario 6	High Recycling - MBT AD - RDF Energy Recovery	-0.12104
Scenario 7	High Recycling - RDF/RDF MBT - RDF to 3rd party burner	0.010742



Using the Defra guidance for calculating the FEC, the calculated Shadow Price of Carbon (SPC) and FEC (NPV) was assessed and scored as shown in Table 4.7 below. This calculation takes into account a shadow price of carbon starting at £26.50/te in 2008, rising at 2% per annum.

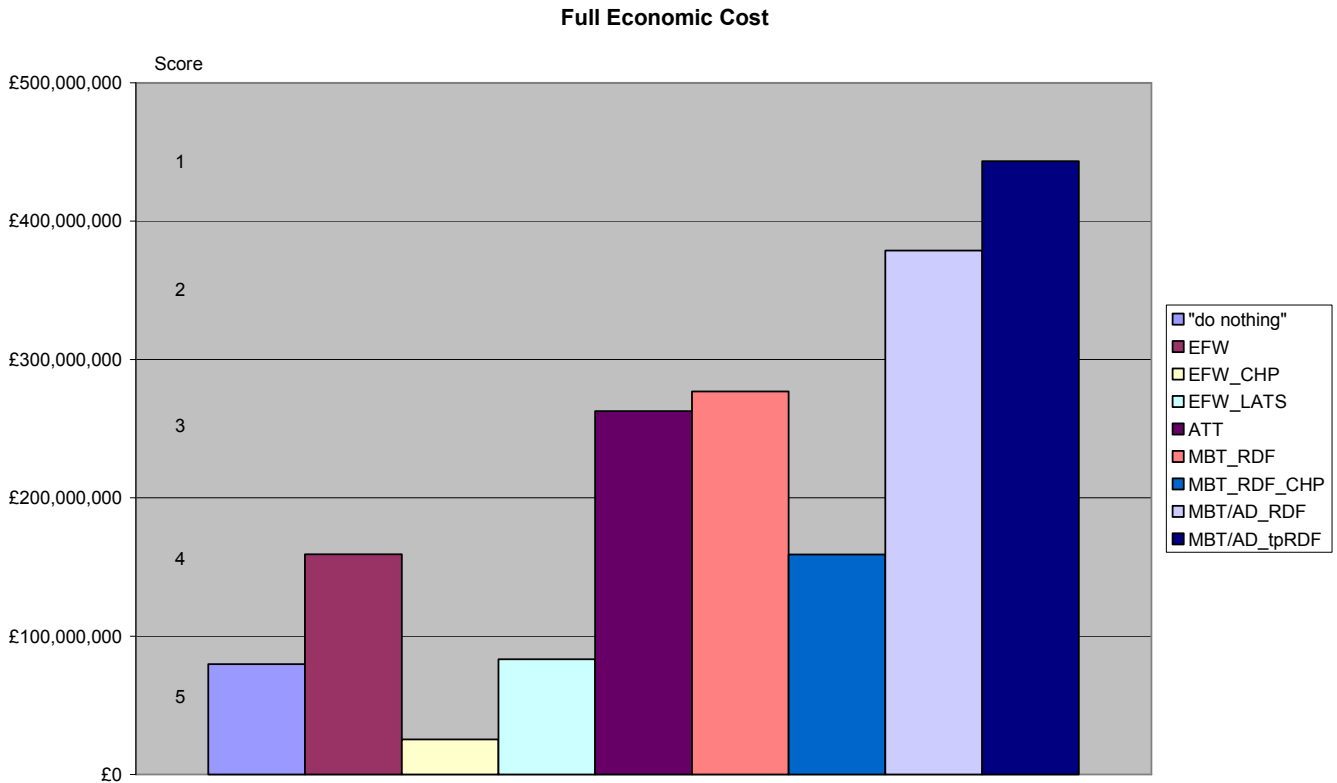
Table 4.6 Full Economic Costs (NPV)

Scenario	Description	SPC	NPV
Scenario 1	Maintain Current Recycling Level - Landfill - Landfill	£36,689,205	£79,731,183
Scenario 2 a	High Recycling – EfW – Maximum residual to EfW to minimise landfill	-£5,751,729	£159,253,610
Scenario 2 b	High Recycling – EfW with CHP Maximum residual to EfW to minimise landfill	-£25,443,466	£25,373,984
Scenario 3	High Recycling - EfW - Meets LATS allowance	£15,503,798	£83,353,288
Scenario 4	High Recycling – ATT – Maximum residual waste to facility to minimise landfill	£12,045,153	£262,714,771
Scenario 5 a	High Recycling - RDF/SRF MBT – RDF to purpose built burner	-£3,041,646	£276,867,196
Scenario 5 b	High Recycling - RDF/SRF MBT to a purpose built burner with CHP	-£38,740,535	£158,979,754
Scenario 6	High Recycling - MBT AD - RDF Energy Recovery	£3,495,110	£378,782,040
Scenario 7	High Recycling - RDF/RDF MBT - RDF to 3rd party burner	-£1,399,481	£443,289,343

The individual FEC are shown in Figure 4.7 below, and the evaluation score given to each option.



Figure 4.7 Full Economic Cost of Each Option



4.4.2 Risk Transfer / Bankability

To ensure a successful bid for PFI funding, local authorities must demonstrate that private sector investment and partnering offers better value for money than financing through the public purse. The additional costs associated with private finance must be offset by transferring risk to the private sector.

Given the long-term nature of PPP/PFI contracts (often in the region of 25 – 30 years) and the requirements for project financing, service providers adopt proven technologies manage the risk transferred by the local authority. If the contractor needs to raise project funds from commercial banks, the banks will require due diligence assessments of the proposed technologies to ensure the robustness of their investments. Some of the considered technologies have not yet progressed beyond demonstration plants, and therefore cannot be said to be proven in the UK. As such, contractors adopting these technologies for long term contracts are exposing themselves to potentially high risks. In these circumstances, the raising of finance from banks is extremely difficult.

A related issue concerns the transfer of planning risk to the private investor. Waste facilities of all types are generally contentious in planning terms, with the outcome dependent on local decision-making processes and less within the control of the contractor.



Experience from signed procurement contracts of this nature has shown that the private sector may not always be willing to accept all risks associated with new and emerging technologies. Therefore, more robust and reliable technologies such as EfW allow more operational risk to be transferred to the private sector.

4.4.3 Exposure to Financial Risk (LATS/Landfill Tax)

This evaluation criterion concentrated on the potential financial risks primarily associated with LATS and landfill tax.

Government policy in recent years has been to increase the financial cost of waste disposal to landfill, and has been achieved through a number of economic instruments, namely the introduction of the landfill tax and the landfill allowance trading scheme. The March 2007 Budget announced increases in the Landfill Tax escalator from £3 per tonne per annum to £8 per tonne per annum commencing April 2008. This tax will therefore rise from £24 per tonne in 2007 to £48 per tonne in 2010, with further to be determined.

The LATS risk is also significant for some of the Scenarios modelled. There is a degree of uncertainty over the effectiveness of how much some MBT technologies will reduce the biodegradability of material prior to landfilling. Technologies that comprise solely of thermal treatment will divert all input biodegradable waste from landfill, as all outputs (fly ash and bottom ash) have zero biodegradability.

4.4.4 Summary Financial Scores

	"do nothing"	EFW	EFW_CHP	EFW_LATS	ATT	MBT_RDF	MBT_RDF_CHP	MBT/A Dthere_RDF	MBT/A D_tpR DF
	1	2a	2b	3	4	5a	5b	6	7
Full Economic Cost	3	4	5	5	3	2	3	1	1
Bankability	1	5	5	5	2	4	4	4	4
Exposure to Financial Risk	1	4	3	2	3	3	3	3	1



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5. Weighted Scores for Scenarios Appraisal

The individual scores for each criterion were multiplied by their respective weightings.

The weighted results are presented in Table 5.1.

Table 5.1 Summary of Weighted Scores

	"do nothing"	EFW	EFW_C HP	EFW_LA TS	ATT	MBT_RD F	MBT_R DF_CHP	MBT/AD there _RDF	MBT/AD _tpRDF
Evaluation Criteria	1	2a	2b	3	4	5a	5b	6	7
'track record' of technology	0.40	0.50	0.50	0.50	0.20	0.30	0.30	0.30	0.20
CHP / SRF usage	0.06	0.18	0.30	0.12	0.18	0.18	0.30	0.18	0.24
Flexibility and adaptability of solution	0.36	0.29	0.29	0.29	0.14	0.29	0.29	0.22	0.22
LATS Position / certainty	0.02	0.10	0.10	0.06	0.08	0.08	0.08	0.08	0.08
Operational fit (WCA interface, transport)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Strategic Fit	0.06	0.24	0.30	0.18	0.24	0.24	0.30	0.24	0.24
Availability of Markets / outlets	0.04	0.16	0.12	0.16	0.16	0.16	0.12	0.08	0.08
Material Recycled/Composted BVPI's	0.03	0.06	0.06	0.06	0.06	0.08	0.08	0.08	0.08
Abiotic Resource Depletion	0.03	0.08	0.08	0.05	0.05	0.08	0.08	0.06	0.08
Global warming potential	0.02	0.03	0.05	0.02	0.06	0.08	0.08	0.08	0.08
Human Toxicity	0.02	0.03	0.02	0.02	0.06	0.08	0.06	0.08	0.06
Freshwater aquatic ecotoxicity	0.02	0.06	0.06	0.03	0.03	0.06	0.06	0.03	0.06
Acidification	0.05	0.15	0.20	0.10	0.10	0.15	0.25	0.10	0.15
Eutrophication	0.04	0.20	0.16	0.12	0.20	0.20	0.16	0.16	0.20
Local Amenity	0.03	0.12	0.12	0.12	0.09	0.09	0.09	0.09	0.06



Table 5.1 (Continued) Summary of Weighted Scores

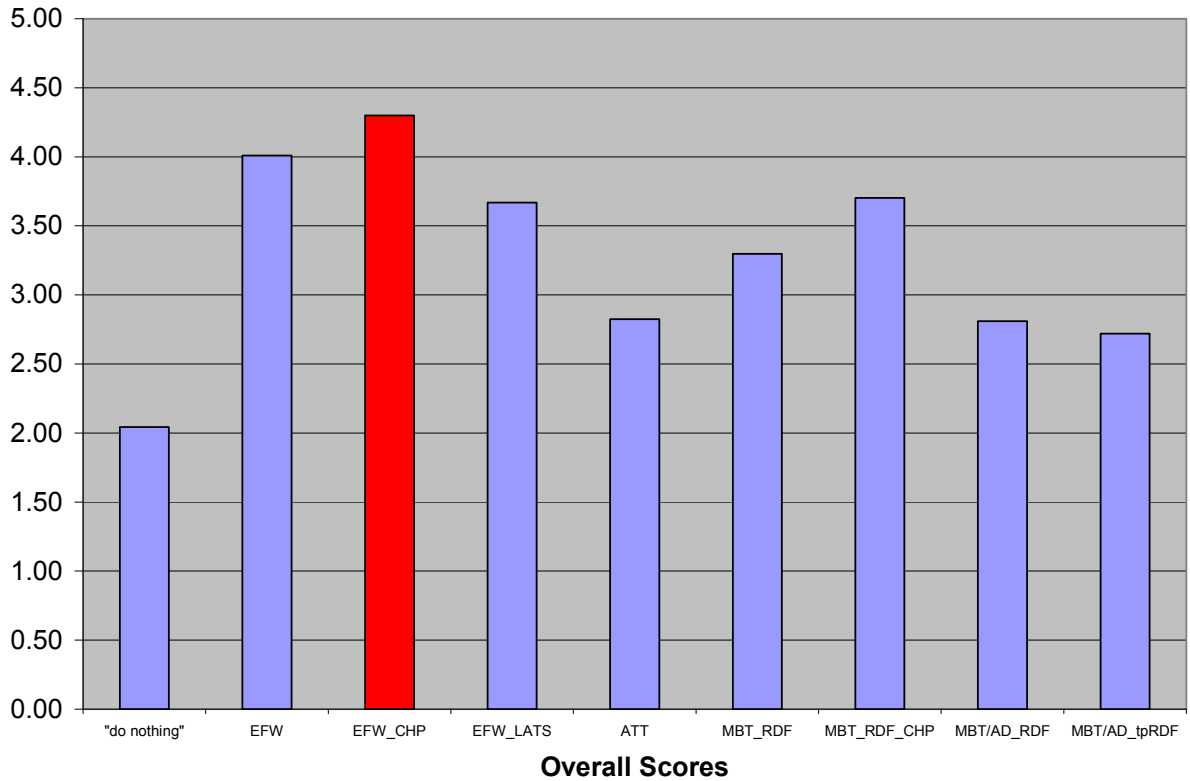
	"do nothing"	EFW	EFW_C HP	EFW_LA TS	ATT	MBT_RD F	MBT_R DF_CHP	MBT/AD there _RDF	MBT/AD _tpRDF
Evaluation Criteria	1	2a	2b	3	4	5a	5b	6	7
Public Opposition / Support	0.02	0.04	0.06	0.04	0.04	0.06	0.08	0.06	0.08
Cost of Solution	0.60	0.80	1.00	1.00	0.60	0.40	0.60	0.20	0.20
Risk Transfer / bankability	0.12	0.60	0.60	0.60	0.24	0.48	0.48	0.48	0.48
Exposure to financial risk	0.08	0.32	0.24	0.16	0.24	0.24	0.24	0.24	0.08
Technical Score	1.03	1.58	1.72	1.42	1.12	1.39	1.53	1.24	1.20
Env/Social Score	0.22	0.71	0.74	0.49	0.63	0.79	0.85	0.65	0.76
Economic Score	0.80	1.72	1.84	1.76	1.08	1.12	1.32	0.92	0.76
Total Score	2.04	4.01	4.30	3.67	2.83	3.30	3.70	2.81	2.72



6. Results of Options Appraisal

The following chart shows the total weighted results from the options appraisal.

Figure 6.1 Total Weighted Results from Options Appraisal



The total assessment score shows that 50% recycling and composting, minimising landfill, Energy from Waste with Combined Heat and Power to minimise landfill was the highest ranking option.



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7. Sensitivity Analysis

7.1 Basis for Sensitivity Analysis

To confirm the robustness of the output, the original weightings selected were tested to see if a different set of weightings would have a significant impact on the results.

In each of the following tests, the balance of weightings was altered to significantly consider either the technical, environmental or economic aspects of the evaluation.

7.2 Increasing Environmental Criteria

The Environmental Criteria was increased from 20% to 50% and the other two criteria, technical and economic reduced to 25% each, as shown in the following table.

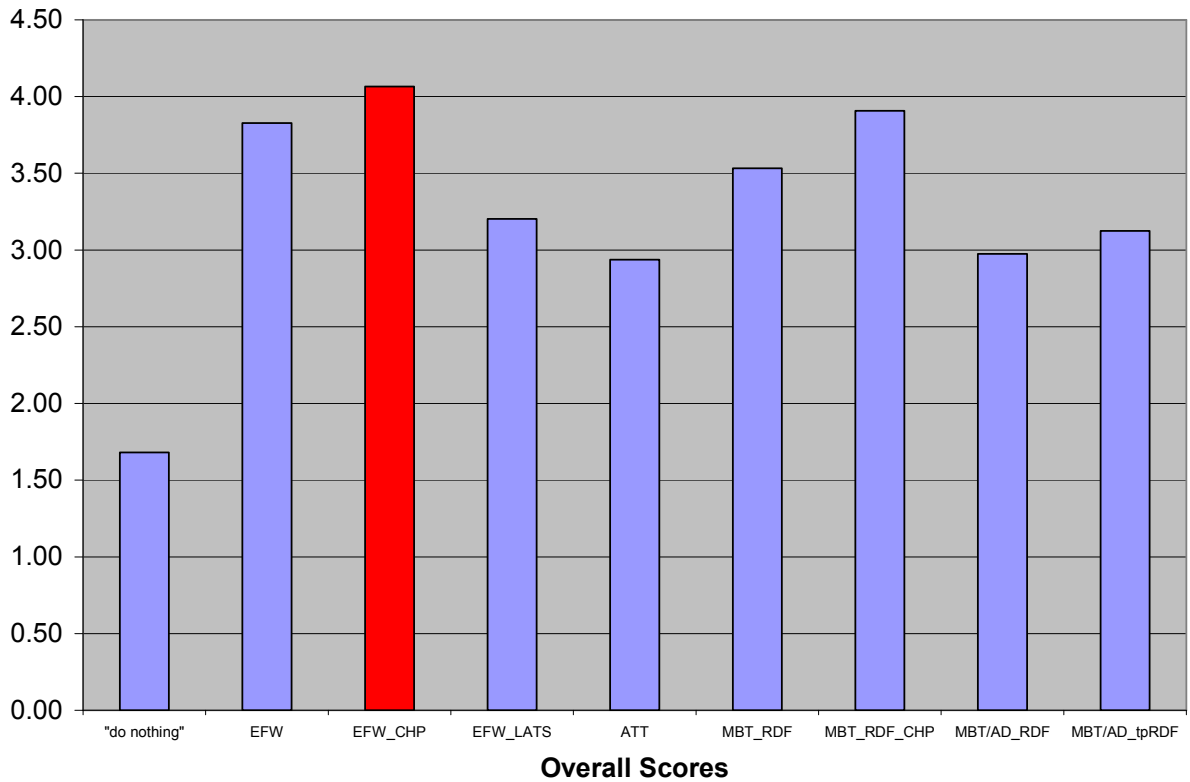
Table 7.1 Sensitivity, Increasing Environmental weighting

Main Criteria	Weighting %
Technical	25
Environmental	50
Economic	25
Social	0
Other, e.g. Fit with Waste Strategy	0
Total	100

The total adjusted score is shown in the figure 7.1.



Figure 7.1 Options Results for Increased Environmental Weighting



The results show that when adjusting the weightings in favour of environmental factors, the Energy from Waste – CHP to minimise landfill still ranks the highest.

7.3 Increasing Economic Criteria

The Environmental Criteria was increased from 40% to 50% and the other two criteria, technical and environmental reduced to 25% each, as shown in the following table.

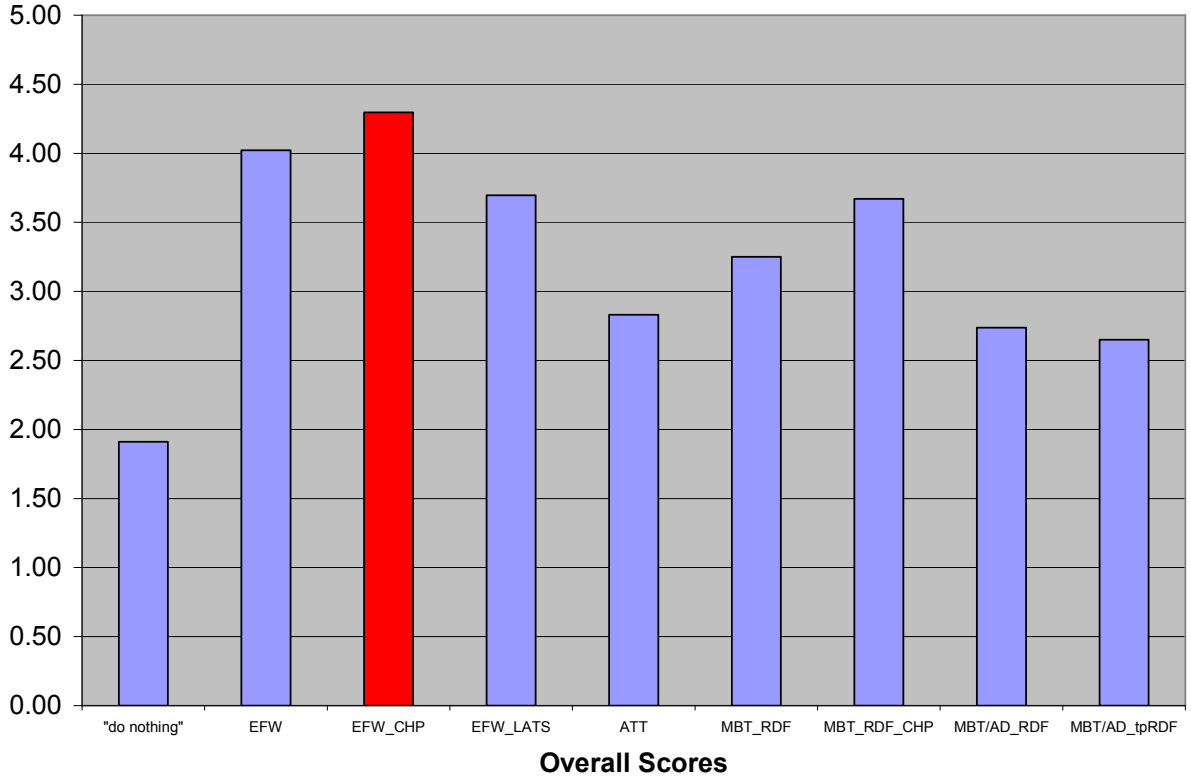
Table 7.2 Sensitivity, Increasing Economic Weighting

Main Criteria	Weighting %
Technical	25
Environmental	25
Economic	50
Social	0
Other, e.g. Fit with Waste Strategy	0
Total	100



The total adjusted score is shown in the figure 7.2.

Figure 7.2 Options Results for Increased Economic Weighting



The results show that when adjusting the weightings in favour of economic factors, the Energy from Waste – CHP to minimise landfill still ranks the highest.

7.4 Increasing Technical Criteria

The Technical Criteria was increased from 40% to 50% and the other two criteria, environmental and economic reduced to 25% each, as shown in the following table.

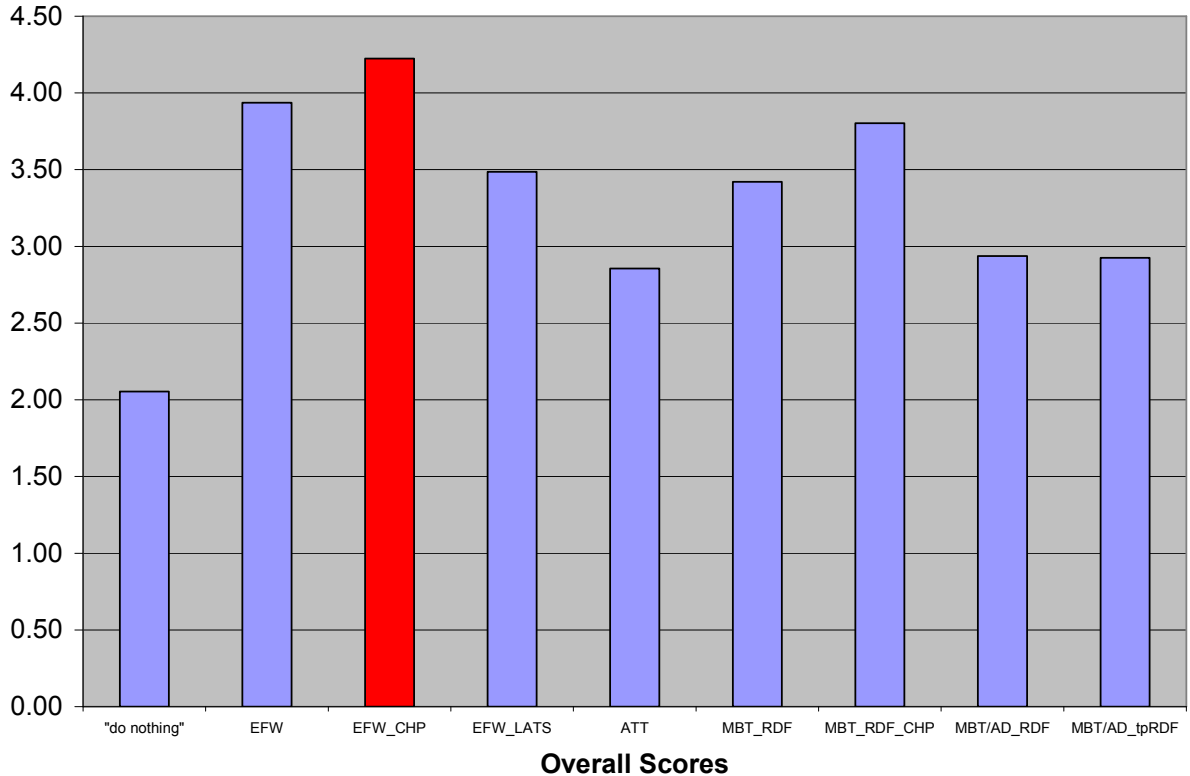
Table 7.3 Sensitivity, Increasing Technical Weighting

Main Criteria	Weighting %
Technical	50
Environmental	25
Economic	25
Social	0
Other, e.g. Fit with Waste Strategy	0
Total	100



The total adjusted score is shown in the figure 7.3.

Figure 7.3 Options Results for Increased Technical Weighting



The results show that when adjusting the weightings in favour of technical factors, the Energy from Waste – CHP to minimise landfill still ranks the highest.

7.5 Post-Workshop Update

All the numbers used within this report were the numbers presented to, discussed and evaluated at the Options Appraisal Workshop.

Further review of the options appraisal exercise has looked at the final waste flow models right up to the presentation of the Outline Business Case. This includes some revision of the Full Economic Case figures, and took into account some minor updates within the waste flow model.

These revised figures were checked against the initial workshop outputs, and whilst there were a few minor differences, the overall output from the workshop is unaltered.



8. Final Outcome – Selection of Reference Case

Taking into consideration the outputs from the options appraisal and the results of the sensitivity analysis, the OBC Options Appraisal indicates that the reference case for Project Transform OBC should be:

High recycling & composting (50%), Energy from Waste with Combined Heat and Power to minimise residual waste sent to landfill.

