Buckinghamshire County Council

&

Milton Keynes Council

Waste Management Technical Options Appraisal

Formal Issue

Version 2

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Contents

Executive Summary

In line with the Local Authorities across the United Kingdom the authorities of Buckinghamshire County Council (BCC) and Milton Keynes Council (MKC) are required to consider the best way forward with regard to managing municipal solid waste (MSW). This report considers the importance of Front End Recycling, the implication of LATS, available technologies and the potential for joint working between BCC and MKC to manage MSW.

The EU Landfill Directive prescribes the amount of Biodegradable Municipal Waste (BMW) that can be landfilled, with key target years of 2009/10, 2012/13 and 2019/20. In addition there are a series of targets, that include those from Waste Strategy 2000, those recommended in the Strategy Unit report (2002), the South Eastern Regional Assembly Waste Management Strategy (RWMS) (Draft 2003) or locally agreed targets in the BCC (2001, currently under review) and MKC (2004) Waste Strategies that encourage authorities to aspire to a level of recycling performance that is perceived to be achievable.
In order to attract PFI funding DEFRA expects recycling/ composting targets to be stretched and that thermal options should not exclude opportunities for recycling/ composting.

Best Value Performance indicators (BVPIs)

By default a contractual arrangement will have to comply with either BVPI's or locally set targets. Therefore it has been assumed that the Front End Recycling performance will be at the 'optimum' level, and the technology solution will follow from there. This assumes (unless otherwise stated) that MKC, and BCC and its Districts are able to fund and implement schemes to provide optimum level recycling.

Landfill Allowance Trading Scheme (LATS)

The results from the assessments have identified that there are nine technology arrangements that can be applied to either meet LATS (10% buffer) or exceed LATS (enhanced permit trading). Not one of these arrangements excludes the need for thermal treatment.

Value For Money (VFM)

The nine technology arrangements include different forms of front-end and thermal treatment and consequently the whole life Net Present Value (NPV) varies significantly. The NPVs range from £170m up to £300m (figures rounded).

Joint Working

Whilst joint working is supported by the economies of scale associated with high throughput, the success of such an arrangement is very much dependent upon the alignment of local waste strategy and policy.

1 Introduction

This report forms the first half of an options appraisal, intended to enable the authorities of Buckinghamshire County Council (BCC) and Milton Keynes Council (MKC) to make informed decisions (either together, or separately) upon the best technical approach for the long term treatment / management of municipal solid waste (MSW).

The rules governing the management of MSW are prescriptive. Every authority is obliged to comply with Best Value Performance Indicators (BVPIs) set by the Office of Deputy Prime Minister (ODPM), for example on recycling and composting. The EU Landfill Directive prescribes the amount of Biodegradable Municipal Waste (BMW) that can be landfilled, with key target years of 2009/10, 2012/13 and 2019/20. The Landfill Directive targets are translated in England under the Landfill Allowance Trading Scheme (LATS), which sets maximum allowable levels of BMW to be landfilled for each year from 2005/06. Non-compliance with BVPI targets could ultimately lead to intervention by the Secretary of State; exceeding landfill allowances means an authority must secure enough permits from other authorities or face penalties at £200 per tonne. Nationally, failing the Landfill Directive targets is likely to lead to particularly onerous financial penalties in the order of £500,000 per day; this would likely be passed onto to authorities contributing to that failure.

In addition there are a series of targets, that include those from Waste Strategy 2000, those recommended in the Strategy Unit report (2002), the South Eastern Regional Assembly Waste Management Strategy (RWMS) (Draft 2003) or locally agreed targets in the BCC (2001, currently under review) and MKC Waste Strategies that encourage authorities to aspire to a level of recycling performance that is perceived to be achievable. In order to attract PFI funding DEFRA expects recycling/ composting targets to be stretched and that thermal options should not exclude opportunities for recycling/ composting.

2 Modelling Methodology

2.1 Overview

To consider suitable MSW treatment technology options it is necessary to model waste generation and the multitude of factors such as new houses, population, minimisation, collection methods and that impact upon the quantity and quality of arisings.

The modelling process has been approached in three stages:

- **Front End**
  Models current and future front end collection schemes.

- **Technical**
  Models the effect of different technical options on treating residual waste and managing some front-end collected material.

- **Capital and Operational**
  Models the Capital and Operational costs of the different technical options.

2.2 Qualification

All the modelling exercises have been dependent upon calculations based on three underlying assumptions:

- **The waste composition:**
  Recent waste compositional studies were used for BCC[1] and MKC[2].

- **How much waste there will be**:
  Known waste tonnages were used to predict future waste tonnages using assumptions on waste, population and growth provided by the respective strategies of BCC and MKC.

- **The success of the strategy initiatives:**
  This is termed the capture rate and is described in 2.2.3 below:

2.2.1 Waste Composition

Contractors will assume that the waste composition remains stable throughout the contract period. Furthermore certain technologies are dependant upon composition consistency to maintain functionality and reduce input specification risks i.e. thermal treatment technologies are dependant on calorific value.

Waste composition is in reality, unlikely to remain stable because of the influence of the factors listed above in 2.2 and below in 2.2.2 however, there is no way of predicting or modelling future changes in composition with any degree of accuracy. There is little or no data out there that estimates changes.

[1] Waste and recycling in Buckinghamshire: A Compositional Study
[2] Household Waste Compositional Study April and November 2000 for Milton Keynes

2.2.2 Waste Growth

Historically, the growth rates for waste arisings have fluctuated widely, but can be attributed to two main factors:

- The change in how much waste each person generates, which is connected to many factors such as prosperity, buying more convenience foods, or becoming more environmentally aware; and,
- The change in the total population or construction of new houses – more people can mean more waste.

We have examined historic trends in the waste generation rate per household/person for each Council, and made projections into the future, taking account of waste minimisation initiatives. This has then been linked back into future housing/population growth predictions that are made for each Council in order to calculate projected arisings into the future.

Waste prevention is the preferred waste management solution and involves eliminating and avoiding the generation of waste at source. Together with re-use, it reduces the amount of waste that has to be dealt with by waste management and disposal facilities. There are a number of options available to promote waste reduction, such as education, re-use centres, home composting and changes to manufacturing processes. We have incorporated the possible effects of waste prevention into the growth projections.

In the future we anticipate an overall slowing in the waste growth per household due to factors that include, but are not limited to:

- Changes in consumer purchasing behaviour;
- Success in waste avoidance/minimisation campaigns on a local and national scale;
- Improvements in product and packaging design, particularly through the Packaging and Producer Responsibility regulations; and,
- Households using disposable income to buy ‘experiences’ (tourism etc) rather than products.

Overall, we have assumed that there will be a 0.2% minimisation in the tonnage of waste generated per household in BCC until 2020. After this time waste arisings per household will stay at a constant level, and the only effect on waste growth within the region will be due to an increase in households/ population. This minimisation rate brings waste arisings per household to around 1996/1997 levels in 2020. It would be necessary to conduct a far more detailed study into the present and future socio-demographics of the area to predict the minimisation effect any more accurately.

This waste minimisation effect in BCC s counteracted by the total increase of the number of households in each district. The average MSW growth per year over the next 25 years used in BCC is therefore:

BCC: 0.6%

MKC have undertaken an independent assessment of future waste trends, which assumes a higher waste growth than that recommended by Jacobs Babtie. This elevation in growth is due to local factors such as increased population and higher historic trends at CRCs. The MKC growth rate has been applied in the Jacobs Babtie waste flow and financial modelling.

The average MSW growth per year over the next 25 years used in MKC is therefore:

MKC: 2.33%

Details of the assumptions used in the underlying growth model can be viewed in Appendix I – Data Assumptions.

2.2.3 Capture Rates

The Capture Rate refers to the amount of a particular waste stream that is diverted by an initiative. There are four components as outlined below:

Percentage Targeted:	The percentage of the waste stream that the Council targets for recycling/ composting.
Percentage Roll Out:	Percentage of households that the Council provides a service to.
Percentage Participation:	Percentage of households offered a service who choose to use it (average over year).
Percentage Recognition (a combination of):	Percentage of participating householders who know what materials can be set out for recycling/ composting?
	Percentage of participating householders who remember to put materials out for recycling/ composting on correct days/ times?
	Percentage of participating householders that are bothered/ or able to set out materials for recycling/ composting at that particular time i.e. the hassle factor of placing materials in the correct box/ receptacle.

Having the most up to date assessment of these factors enables a truer picture of the quantities of waste the various collection initiatives could divert, and in turn the cost-benefit of each.

The Capture Rates for the past three years (2000 to 2003) have been back calculated using the current waste tonnages. 'Participation' rates used were supplied by BCC and MKC.

The 'Roll out' of collection initiatives is known in each of the four districts of BCC and in MKC. The amount of the stream targeted is known for each kerbside collection stream, therefore the Recognition factor can be calculated. For Bring Banks the Targeted and Roll Out factors were known and standard recognitions where used so that Participation could be calculated. The Capture Rates at Bring Banks are calculated on the residual waste after the waste recycled/ composted at kerbside has been taken away.

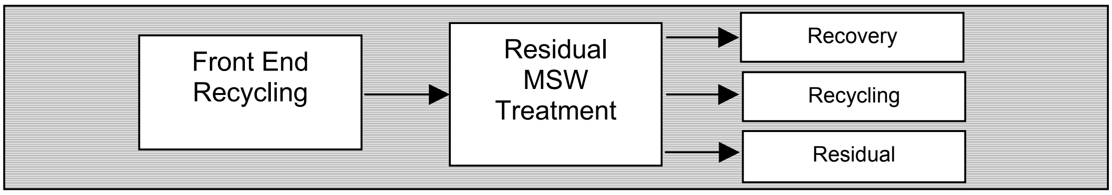
In predicting capture rates in the ‘planned’ scenario it was assumed that there would be no increase in Participation or Recognition, even when Roll out or the targeted streams were increased.

Full details on Capture Rates can be found in Appendix II.

3 Front End Recycling

The term 'Front End Recycling' should be considered as a stage in the process of MSW management as illustrated in Figure 1 below (recycling also includes composting).

Figure 1: Typical MSW Management Process.



The importance of Front End Recycling is that the desired performance will directly effect the next stage in the MSW management process, the residual waste treatment. The Best Value Performance Indicators (BVPI's) provide the benchmark that authorities work to; however, as future targets have yet to be set, other targets have been adopted, and this has included the recommendations made by the Strategy Unit (2002).

Authorities need to determine what targets they aim to work towards, and these targets are apportioned to 'milestone' years. 2010, 2015 and 2020 respectively. In the case of BCC and MKC three tiers of targets have been considered, "low, medium and high".

Table 1: Recycling Targets for BCC and MKC

Target Option	2005	2010	2015	2020
Low (BVPIs)	36%	36%	36%	36%
Medium (Local Strategy)	36%	40%	45%	50%
High (RWMS Adapted)	36%	45%	50%	55%

Both BCC and MKC have produced waste strategies, which describe and prescribe how MSW management obligations will be achieved. Typically the methods applied to Front End Recycling, include:

- Kerbside collection;
- Bring Banks;
- Material Recycling Facilities (MRFs);
- Green Waste Composting (GWC) Plant; and,
- Household Waste Recycling Centres in BCC (HWRCs)/ Community Recycling Centres in MKC (CRCs).

These initiatives are implemented primarily to help authorities to comply with the BVPIs; however, by default (due to the biodegradability of certain waste streams) they also contribute to BMW diversion.

The first stage of the modelling exercise has been to evaluate the performance of both BCC and MKC against the three tiers of targets based upon existing and intended initiatives, referred to as 'planned front end recycling and optimised front end recycling' respectively. The initiatives were taken from the respective waste strategies of both BCC and MKC. The existing and future performance was based upon previous data, current and future growth predictions. The modelled performance was then considered against the various targets. The results can be seen in Tables 4 and 5 below.

The two scenarios for Front End Recycling systems that were been modelled are:

‘Planned’ Front End Recycling and Composting Initiatives:

- All current initiatives are implemented; and,
- That there would be no increase in participation or recognition throughout the contract, even when the Roll out of the targeted streams is increased.

‘Optimised’ Front End Recycling and Composting Initiatives:

- All current and planned initiatives are implemented; and,
- Front End Recycling systems are pushed out to maximum (increasing participation and/ or recognition, roll out and targeted streams to maximum).

These two models are calculated in the same way, the only difference between the two is that the ‘Optimised’ model pushes out the front end recycling system to a maximum (although only to a level that is perceived to be realistic, in terms of technical performance and the ‘human factor’). The ‘recycled tonnage’ predictions were calculated individually for BCC and MKC.

3.1 Planned Front End Recycling and Composting Initiatives

This scenario models the current waste tonnages and collection arrangements. It also includes current Planned Initiatives for BCC and MKC (Tables 2 & 3).

Table 2: Planned Front End Recycling and Composting Initiatives for BCC.

2003/04	BCC (HWRC)	Extend 2 Household Waste Recycling Facility (HWRCs) (Buckingham & Amersham HWRC)	
	CDC	Enhance kerbside for paper and glass	
	SBDC	Enhance existing recycling schemes	Provision of kerbside glass
	WDC	Paper collection WITH BOXES to 85% of WDC households	
2004/05	BCC (HWRC)	High Heavens HWRC expansion Autumn 2004	Chesham HWRC expansion in 2004/05
	AVDC	Kerbside monthly collection of glass to 90% of residents (starts Oct 2004)	
		5 new bring sites	
	CDC	Kitchen waste commencing Feb 05 2004/05 78 tonnes	
	SBDC	Kitchen waste commencing March 05 2004/05 90 tonnes	
	WDC	Green waste kerbside collection to 18% of residents (12,000 properties)	
		Kitchen waste commencing June 04 1874 tonnes	
2005/06	BCC (HWRC)	Relocate Beaconsfield Site	Extend 2 HWRCs
	CDC	Green/Kitchen 2005/06 2062 tonnes	
	SBDC	Green/Kitchen 2005/06 2350 tonnes	
	WDC	Green/Kitchen waste 2005/06 6875 tonnes (36% - 24,000 Properties)	
2006/07	SBDC	Green/Kitchen waste 2006/07 3800 tonnes	
	WDC	Kerbside can / plastic collections to properties (18% 12,000 properties)	
2007/08	BCC (HWRC)	Amersham HWRC expansion	Provide one or more HWRCs for the County
	WDC	Kerbside can / plastic collections to properties (85% total coverage) properties	
2010/11	WDC	Roll out of plastic, and cans for WDC to remaining 15%	

The Four districts in BCC are:
AVDC - Aylesbury Vale District Council;
CDC - Chiltern District Council;
SBDC – South Bucks District Council; and,
WDC – Wycombe District Council.

Table 3: Planned Front End Recycling and Composting Initiatives for MKC.

2003/04	Kerbside collection at 100% roll-out (pink mixed bags)
	Introduction of Garden waste Kerbside collection to 21,000 houses
2004/05	Expansion of Garden waste Kerbside collection to 25,000 houses
2005/06	Food Waste collection trial in 05/06 (1000 properties) trial
	Increase Garden waste Kerbside collection to 28,000 houses
	WEEE introduced at CRCs (increase recycling and inerts collected by 3%)
2006/07	Some sort of VCU built in 06/07 (not funded)
	Increase food Waste collection to 2,000 houses
	4th Community Recycling Centre (CRC) built 05/06 this will improve the recycling rate at the sites to hopefully around 35%
2007/08	Increase food Waste collection to 91,000 houses
	Free Garden waste collection offered to those with gardens

The actual implementation of these initiatives is obviously dependant on many factors, not least financial, but for the purposes of modelling it has been assumed they are all implemented.

Table 4: BCC Composting and Recycling Performance based upon 'Planned' initiatives.

	2005	2010	2015	2020
'Planned' Initiatives - Recycling / Composting Performance	31%	35%	35%	35%
Low target achieved	No	No	No	No
Medium target achieved	No	No	No	No
High target achieved	No	No	No	No

Table 5: MKC Composting and Recycling Performance based upon 'Planned' initiatives

	2005	2010	2015	2020
'Planned' Initiatives - Recycling / Composting Performance	27%	33%	33%	33%
Low target achieved	No	No	No	No
Medium target achieved	No	No	No	No
High target achieved	No	No	No	No

3.2 Optimised Front End Recycling and Composting Initiatives

The results from Table 4 and 5 confirm that to continue without any further 'improvement in planned initiatives both BCC and MKC will continue to fail all three tiers of targets. In order to improve upon this performance a series of additional front-end initiatives were modelled

The second 'Optimised' scenario took the 'Planned' scenario and introduced new initiatives to increase front end recycling rates to a 'maximum'. This included:

- Introducing new Kerbside and Bring Bank Schemes so that all streams are covered by 2010;
- Introducing and expanding materials that are able to be recycled in each steam (increase % Targeted) by 2010;
- Gradually increasing participation and recognition rates to a maximum in 2020[3]; and,
- Increasing Roll out to 100% wherever possible.

These additional initiatives considered what is believed to be the best likely performance both technically and humanly possible and are described in Tables 6 and 7 below.

[3] Maximum standards as given in the Strategy Unit Report (2002) – Recycling Participation Report.

Table 6: Proposed additional initiatives to Optimise BCCs Front End Recycling

District	Year	Stream	K/s & BB		Targeted	Roll out	Participation	Recognition
AVDC	2007	Organic	K/s	Introduce a kitchen and green waste collection	93%	90%	60%	60%
AVDC	2010	Fe	K/s & BB	Increase Targeted by introducing aerosols	75%	No change	No change	No change
AVDC	2010	Fe	K/s	Steadily increase participation/recognition rates	No change	No change	87%	50%
AVDC	2010	Glass	K/s	Increase roll out to 100%	No change	100%	No change	No change
AVDC	2010	Glass	BB	Reduce participation	No change	No change	30%	No change
AVDC	2010	Glass	K/s	Steadily increase participation/recognition rates	No change	No change	87%	70%
AVDC	2010	Non Fe	K/s & BB	Increase Targeted by introducing aerosols and foil	84.5%	No change	No change	No change
AVDC	2010	Non Fe	K/s	Steadily increase participation/recognition rates	No change	No change	87%	50%
AVDC	2010	Paper	K/s & BB	Increase Targeted by introducing card	78%	No change	No change	No change
AVDC	2010	Paper	K/s	Steadily increase participation/recognition rates	No change	No change	87%	90%
AVDC	2010	Plastic	K/s	Steadily increase participation/recognition rates	No change	No change	87%	65%
AVDC	2015	Fe	K/s	Steadily increase participation/recognition rates	No change	No change	90%	70%
AVDC	2015	Glass	K/s	Steadily increase participation/recognition rates	No change	No change	90%	80%
AVDC	2015	Glass	K/s	Steadily increase participation/recognition rates	No change	No change	No change	90%
AVDC	2015	Non Fe	K/s	Steadily increase participation/recognition rates	No change	No change	90%	70%
AVDC	2015	Organic	K/s	Steadily increase participation/recognition rates	No change	No change	70%	70%
AVDC	2015	Plastics	K/s	Steadily increase participation/recognition rates	No change	No change	90%	70%
CDC	2010	Fe	K/s	Introduce a Fe waste collection	47.70%	100%	70%	60%
CDC	2010	Fe	K/s & BB	Increase Targeted by introducing aerosols	55%	No change	No change	No change
CDC	2010	Non Fe	K/s & BB	Increase Targeted by introducing aerosols and foil	51.70%	No change	No change	No change
CDC	2010	Non Fe	K/s	Introduce a Non Fe waste collection	47.40%	100%	70%	60%
CDC	2010	Plastics	K/s	Introduce a plastic waste collection	39.30%	100%	70%	60%
CDC	2010	Organic	K/s	Steadily increase participation/recognition rates	98.30%	No change	No change	No change
CDC	2010	Paper	K/s	Steadily increase participation/recognition rates	No change	No change	87%	No change
CDC	2010	Glass	K/s	Steadily increase participation/recognition rates	No change	No change	87%	70%
CDC	2010	Organic	K/s	Steadily increase participation/recognition rates	No change	No change	70%	No change
CDC	2015	Paper	K/s	Steadily increase participation/recognition rates	No change	No change	90%	No change
CDC	2015	Plastics	K/s	Steadily increase participation/recognition rates	No change	No change	90%	70%
CDC	2015	Glass	K/s	Steadily increase participation/recognition rates	No change	No change	90%	90%
CDC	2015	Fe	K/s	Steadily increase participation/recognition rates	No change	No change	90%	70%
CDC	2015	Non Fe	K/s	Steadily increase participation/recognition rates	No change	No change	90%	70%
SBDC	2010	Fe	K/s & BB	Increase Targeted by introducing aerosols	57.4%	No change	No change	No change
SBDC	2010	Non Fe	K/s & BB	Increase Targeted by introducing aerosols and foil	53.3%	No change	No change	No change
SBDC	2010	Glass	K/s	Increase glass roll out	No change	100%	No change	No change
SBDC	2010	Plastic	K/s	Increase plastic waste collection	49.7%	100%	70%	60%
SBDC	2010	Paper	K/s	Steadily increase participation/recognition rates	No change	No change	80%	No change
SBDC	2010	Glass	K/s	Steadily increase participation/recognition rates	No change	No change	80%	60%
SBDC	2010	Fe	K/s	Steadily increase participation/recognition rates	No change	No change	70%	60%
SBDC	2010	Non Fe	K/s	Steadily increase participation/recognition rates	No change	No change	70%	60%
SBDC	2010	Organic	K/s	Steadily increase participation/recognition rates	No change	No change	70%	No change
SBDC	2015	Paper	K/s	Steadily increase participation/recognition rates	No change	No change	90%	No change
SBDC	2015	Plastic	K/s	Steadily increase participation/recognition rates	No change	No change	90%	70%
SBDC	2015	Glass	K/s	Steadily increase participation/recognition rates	No change	No change	90%	90%
SBDC	2015	Fe	K/s	Steadily increase participation/recognition rates	No change	No change	90%	90%
SBDC	2015	Non Fe	K/s	Steadily increase participation/recognition rates	No change	No change	90%	90%
SBDC	2010	Paper	BB	Introduce a paper bring bank	72.20%	100%	8%	90%
WDC	2010	Plastics	K/s	Increase roll out	No change	100%	No change	No change
WDC	2010	Fe	K/s	Increase roll out	No change	100%	No change	No change
WDC	2010	Non Fe	K/s	Increase roll out	No change	100%	No change	No change
WDC	2010	Fe	K/s & BB	Increase Targeted by introducing aerosols	61.5%	No change	No change	No change
WDC	2010	Non Fe	K/s & BB	Increase Targeted by introducing aerosols and foil	58.1%	No change	No change	No change
WDC	2010	Organic	K/s	Increase roll out	No change	100%	No change	No change
WDC	2010	Paper	K/s	Increase roll out and steadily increase participation rates	No change	100%	70%	No change
WDC	2010	Glass	K/s	Introduce the collection of glass	98.90%	100%	70%	80%

Note: K/S = Kerbside; BB = Bring Bank. Unless otherwise stated the participation/recognition rates given above are achieved in the given year.

Table 7: Proposed additional initiatives to Optimise MKC's Front End Recycling

	Year	Stream	K/s or BB		Targeted	Roll out	Participation	Recognition
MKC	2007	Cans	K/s & BB	Introduce aerosols etc	100%	No change	No change	No change
MKC	2007	Plastics	K/s & BB	Introduce packaging	67%	No change	No change	No change
MKC	2010	Organics – Green	K/s	Steadily increase participation/recognition rate	No change	No change	70%	No change
MKC	2010	Organics – Food	K/s	Steadily increase participation/recognition rate	No change	No change	70%	No change
MKC	2010	Cans	K/s	Steadily increase participation/recognition rate	No change	No change	70%	45%
MKC	2010	Glass	K/s	Steadily increase participation/recognition rate	No change	No change	70%	80%
MKC	2010	Paper	K/s	Steadily increase participation/recognition rate	No change	No change	80%	No change
MKC	2010	Paper	K/s & BB	Introduce drink cartons	85%	No change	No change	No change
MKC	2010	Plastics	K/s	Steadily increase participation/recognition rate	No change	No change	70%	60%
MKC	2015	Organics – Green	K/s	Steadily increase participation/recognition rate	No change	No change	No change	70%
MKC	2015	Cans	K/s	Steadily increase participation/recognition rate	No change	No change	90%	70%
MKC	2015	Glass	K/s	Steadily increase participation/recognition rate	No change	No change	90%	90%
MKC	2015	Paper	K/s	Steadily increase participation/recognition rate	No change	No change	90%	No change
MKC	2015	Plastics	K/s	Steadily increase participation/recognition rate	No change	No change	90%	70%

Unless otherwise stated the participation/recognition rates given above are achieved in the given year.

Table 8: BCC Composting and Recycling Performance based upon 'Optimised' initiatives

	2005	2010	2015	2020
'Optimised' Initiatives - Recycling / Composting Performance	32%	46%	50%	51%
Low target achieved	No	Yes	Yes	Yes
Medium target achieved	No	Yes	Yes	Yes
High target achieved	No	Yes	Yes	No

Table 9: MKC Composting and Recycling Performance based upon 'Optimised' initiatives.

	2005	2010	2015	2020
'Optimised' Initiatives - Recycling / Composting Performance	27%	40%	46%	46%
Low target achieved	No	Yes	Yes	Yes
Medium target achieved	No	Yes	Yes	Yes
High target achieved	No	No	No	No

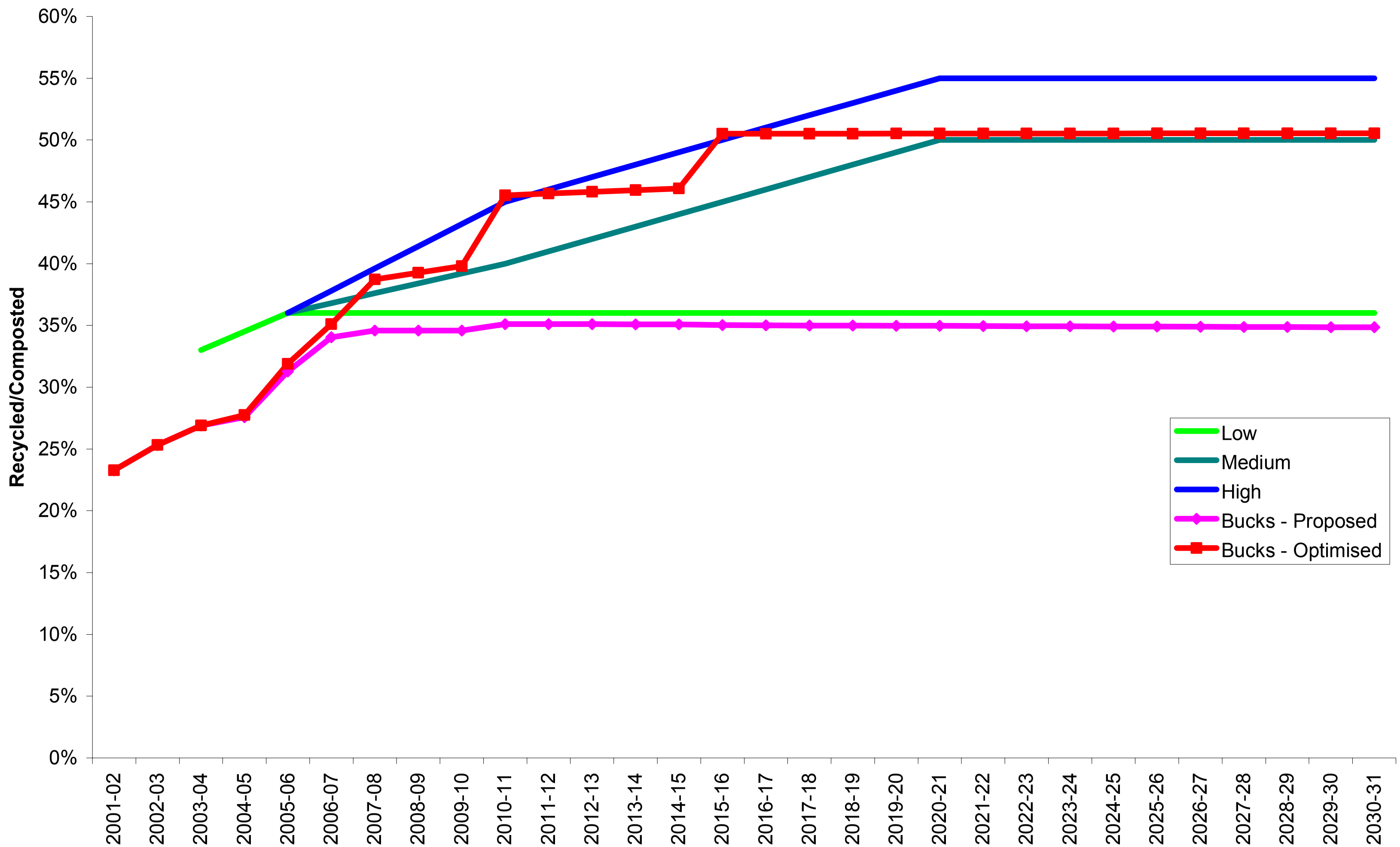
The net effect of 'optimising' front end recycling is to increase the recycling and composting performance of both BCC and MKC.

It is important to recognise that the 'optimisation' is at present hypothetical, and whilst some of the additional initiatives have been confirmed as being likely to be initiated, some may not actually materialise. Furthermore, any capital funding required to implement these additional initiatives has yet to be confirmed. This modelling demonstrates that there is a limit to the performance and contribution that front end recycling can provide towards the management of MSW.

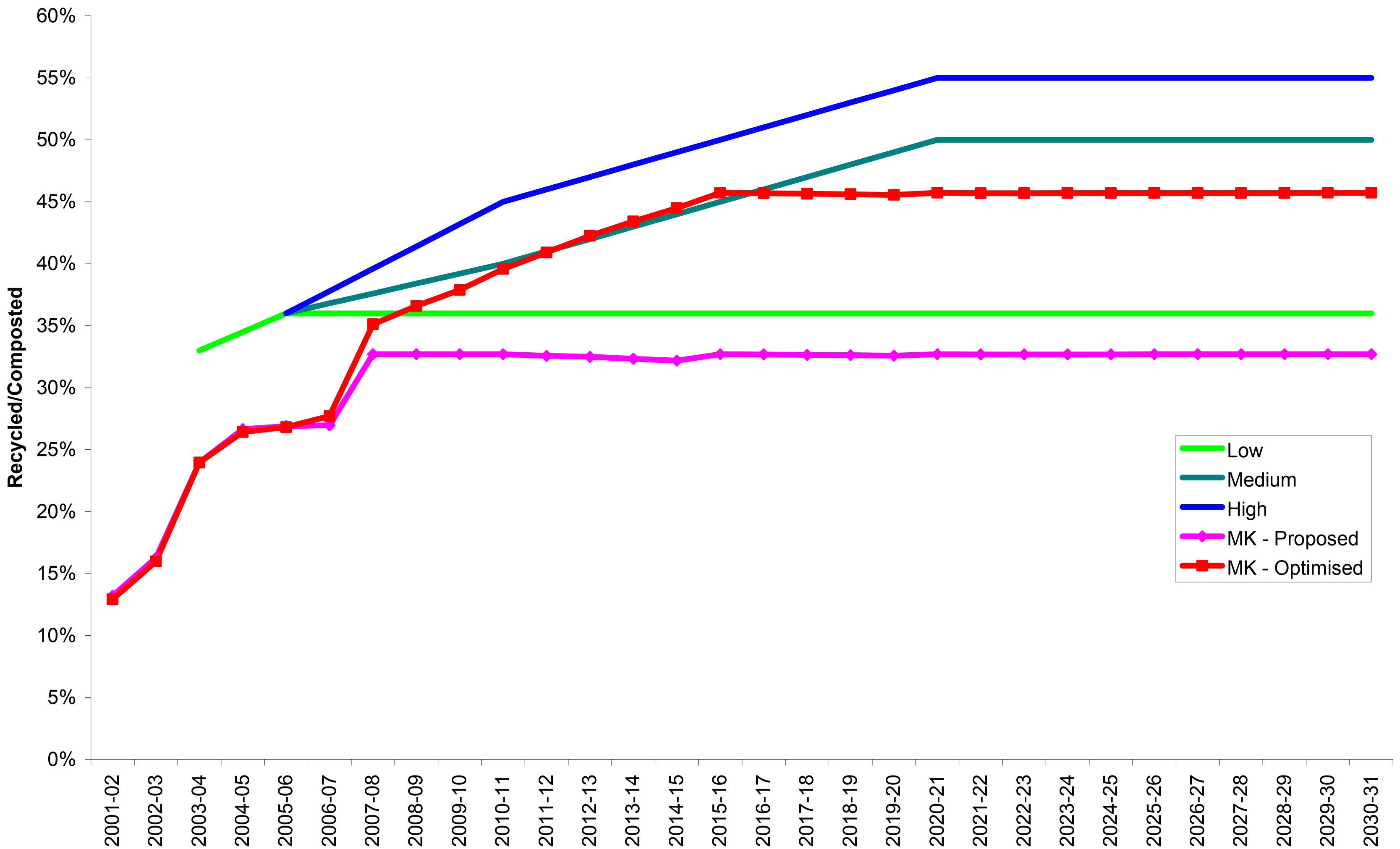
The optimisation of front end recycling also demonstrates that there has been a strong attempt to maximise recycling prior to technology dependency. The comparison of 'Planned' and 'Optimised' Front End Recycling performance for BCC and MKC is demonstrated below in Graphs 1 & 2.

Performance of Buckinghamshire's Districts can be seen in Appendix III.

Graph 1: Comparison 'Planned' and 'Optimised' Front End Recycling Performance – BCC



Graph 2: Comparison 'Planned' and 'Optimised' Front End Recycling Performance – MKC



Whilst the primary purpose of front end recycling is to maximise the amount of pre treatment recycling and composting, the very nature of the waste managed by these additional initiatives contributes towards BMW diversion and consequently LATS targets, as shown below in Tables 10 and 11.

Table 10: Comparison of LATS performance between 'Planned' and 'Optimised' Front End Recycling for BCC

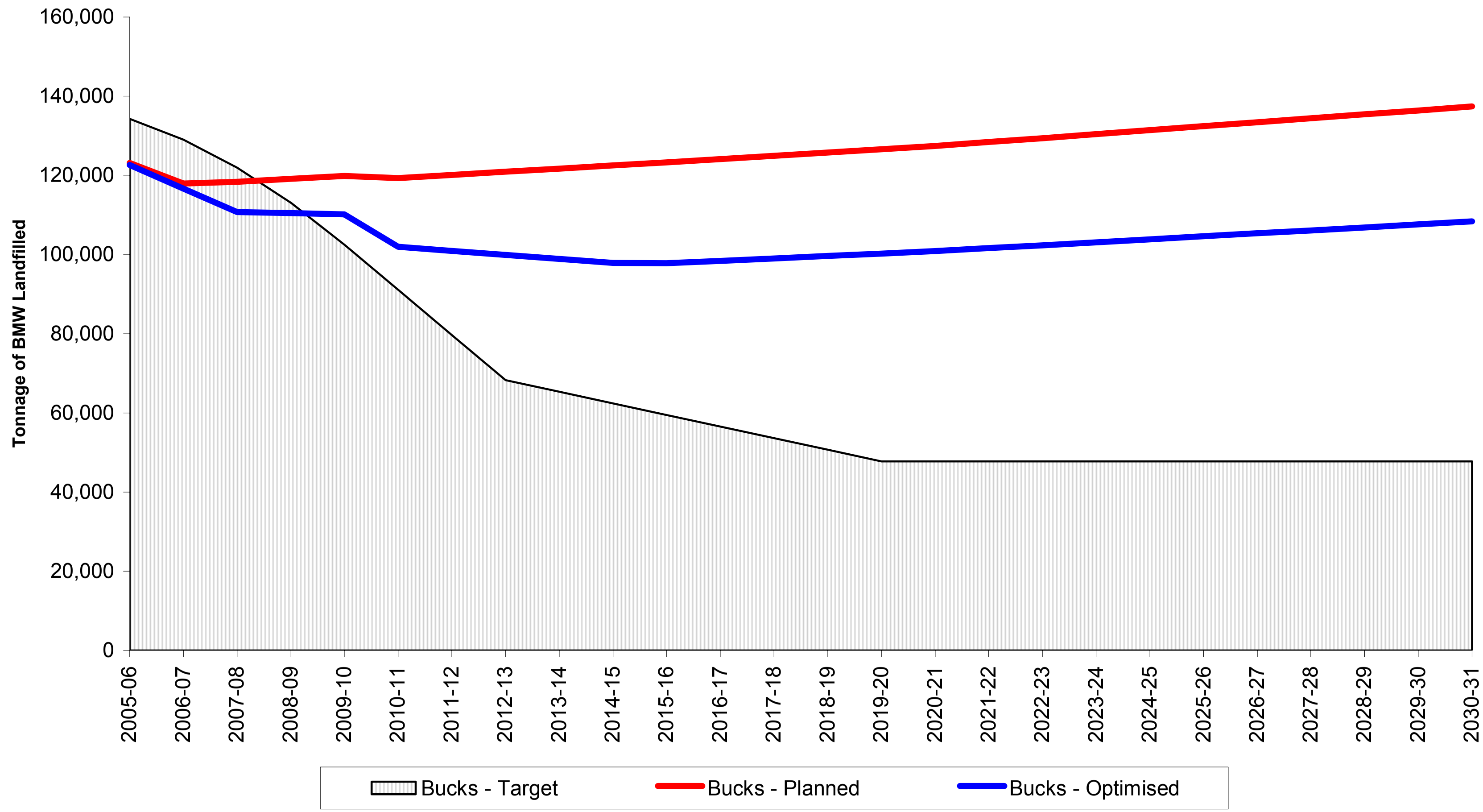
	2005	2010	2015	2020
LATS Targets	134,256	91,089	59,486	47,772
LATS Front End 'Planned'	18,327	-20,045	-55,495	-71,181
LATS Front End 'Optimised'	18,918	-582	-26,847	-41,355

Table 11: Comparison of LATS performance between 'Planned' and 'Optimised' Front End Recycling for MKC.

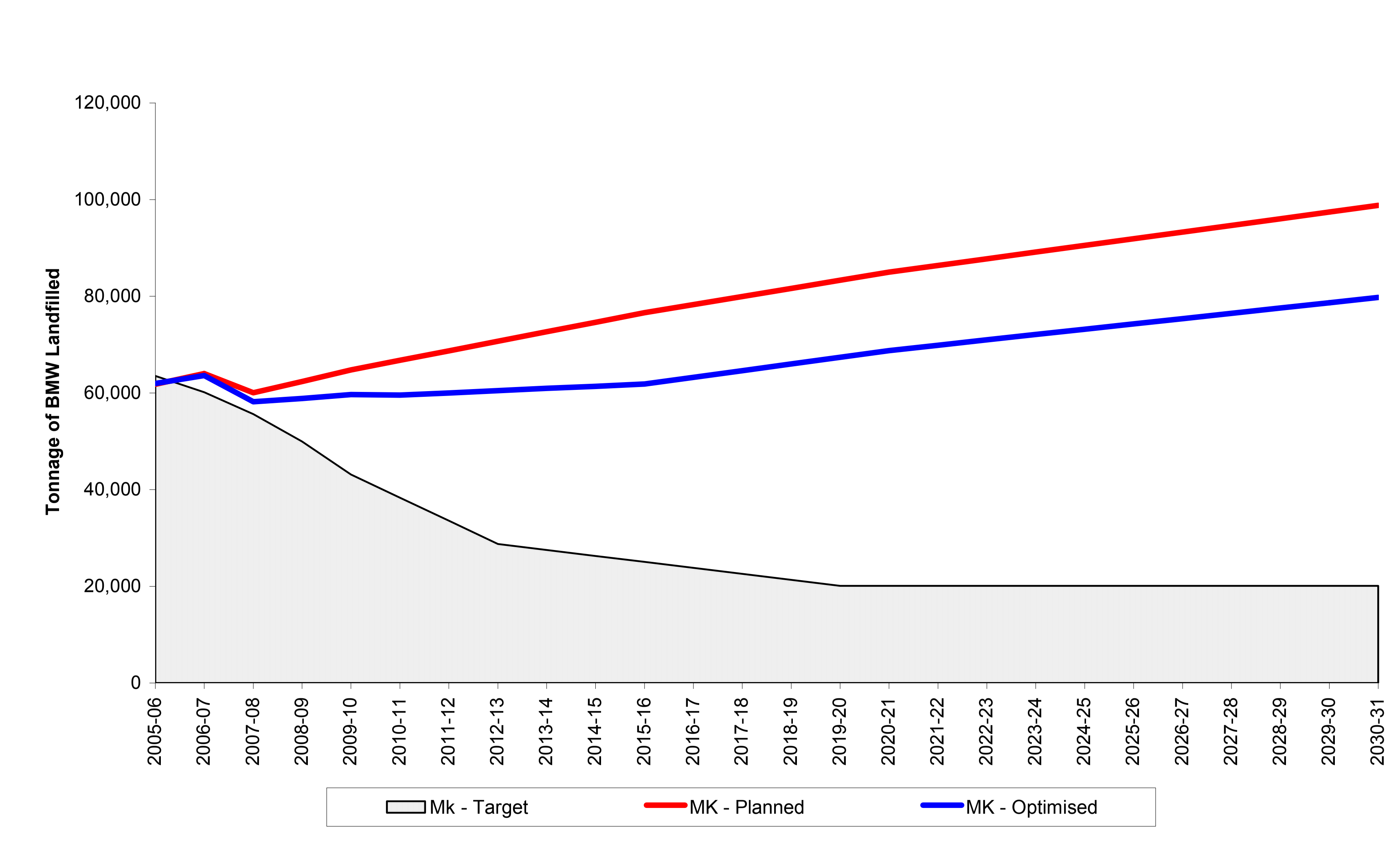
	2005	2010	2015	2020
LATS Targets	63,547	38,352	25,046	20,114
LATS Front End 'Planned'	3,942	-20,474	-40,641	-53,133
LATS Front End 'Optimised'	3,858	-13,362	-26,830	-38,060

The LATS performance for BCC and MKC is represented graphically below (graphs 3 & 4). Performance graphs for the districts of BCC can be seen in Appendix IV.

Graph 3: Comparison 'Planned and 'Optimised' Front End Recycling Performance against LATS targets for BCC



Graph 4: Comparison ‘Planned’ and ‘Optimised’ Front End Recycling Performance against LATS targets for MKC



4 Treatment Technology Assessment

The front-end recycling assessments have identified that there is a significant shortfall in Front End Recycling Performance, but also in BMW diversion from landfill or LATS compliance. Although 'Optimising' front end recycling has offered some improvement, further effort is required in order for both BCC and MKC to become compliant and if so desired, go beyond compliance of LATS.

The very nature of LATS removes the most common and traditional form of waste disposal i.e. landfill from the options available. Therefore in the near future it will be necessary to procure and utilise other forms of technology to treat residual MSW arisings.

4.1 Contract Timing

A 24-year contract for waste management services to treat waste from BCC and MKC has been modelled in this options appraisal for both BCC and MKC. This is arguably the minimum contract period on which to build a major waste management facility, based on the lifespan of technology use i.e. before major renewal of equipment. It is also based on the period necessary to make repayments on loans used to deliver facilities allowing adequate time to begin to make returns on the technology investment. The length of contract is a matter of discussion that will need to be considered when deciding on preferred procurement options and routes, and indicated in the contract documentation. Once a firm contract duration is agreed upon, the Jacobs Babtie waste flow and financial models can be revised to extend this period if necessary.

Contract year one is assumed to commence on 1 April 2007 and run until March 31 2008. The first Landfill Directive target year finishes on 31 March 2010. As such, it is desirable for appropriate treatment technologies to be operational in time to process enough waste in order to meet this first target. The financial implications for the UK of not meeting this target are likely to be considerably onerous and every effort must be made nationally to ensure that penalties are averted.

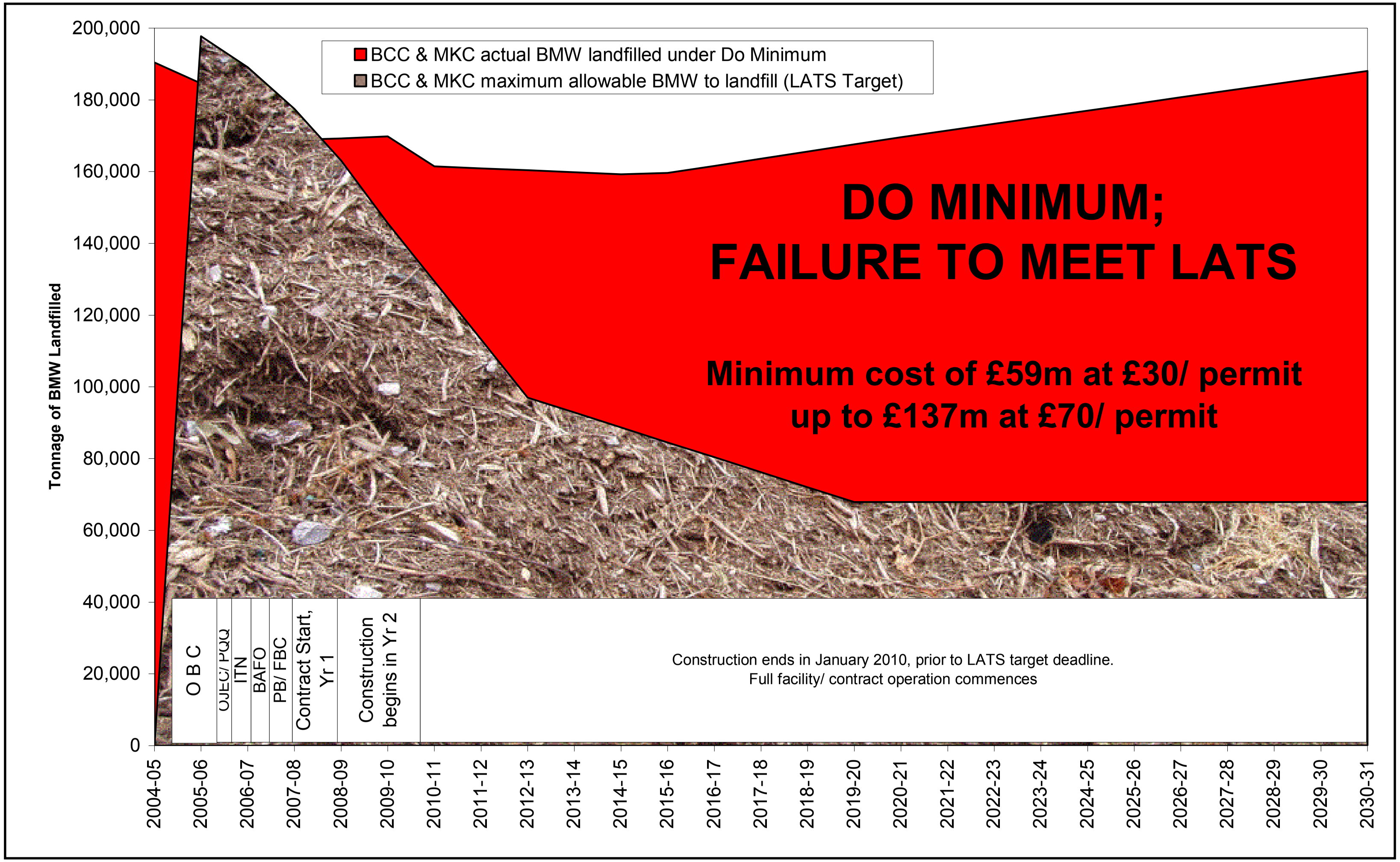
To meet this demanding timescale Jacobs Babtie have modelled the construction of treatment technologies during contract year two and contract year three, with commissioning in contract year three.

In order to meet with this construction timetable, it has been assumed that planning approval would be gained towards the end of contract year one, and that following best practice, applications could be submitted during the preferred bidder stage of the procurement process.

To add impetus to this demanding schedule it is prudent to note that the procurement process itself is likely to last two years, underlining the need to expedite decisions on preferred options and preferred procurement routes. Graph 6 below illustrates the need to construct a suitable treatment infrastructure and avert the costs of failing to meet prescribed LATS targets.

If construction and commissioning was delayed beyond contract year three alternative arrangements may need to be made for processing waste. In addition, costs would rise, for example, as CAPEX expenditure would be greater due to inflation, OPEX would rise because of the potential need to purchase LATS permits from other authorities. or third party facilities may well be used at a premium price to avert permit buying costs.

Graph 6: An illustration of the procurement, construction and operational time-scale of a joint working waste management contract against the combined BCC and MKC LATS targets and the performance under a **Do Minimum** scenario.



4.2 Technology Options

The waste management industry is currently in a state of flux, reacting to new and imminent legislation. Moreover there are a variety of technologies and service providers available. Some technologies are tried and tested and some are still being established. Nevertheless there **are** solutions that can be applied.

As indicated in Appendix VI, a number of facilities will be required to treat materials recovered from the kerbside, from bring banks and from HWRCs/ CRCs.

Front End Treatment

It has been assumed that these facilities will, on the whole, be financed through the contract. MKC indicated in correspondence the following infrastructure assumptions:

- Bulky MRF, £2 million, contract to finance
- Food Waste composting facility i.e. IVC, £2.5 million, contract to finance
- MRF major upgrade, £2 million, MKC to finance
- Transfer Station, £1 million, MKC to finance
- CRC major upgrade, £1 million, MKC to finance
- Food waste containers, £1.2 million, MKC to finance.

The two elements that MKC would like to form part of the contract have been included in the modelling. The fixed CAPEX is assumed to be payable (i.e. the facility constructed) over contract years two and three.

Whilst MKC have indicated that CRC and MRFs would be financed through other means the operational costs of these facilities has been modelled to be included in the contract i.e. in the Net Present Values (NPV) determined for the contract.

For BCC and MKC, it has been assumed that the construction and operation of GWC facilities would be provided in and financed in the contract, as this is a service that the majority of bidders will be able to offer.

For BCC we have assumed operating costs of running HWRCs. We have assumed that both capital and operating costs of a MRF would be financed through the contract, as well as an IVC facility and WTS.

In modelling the joint working contract we have taken into account the assumptions provided by MKC, in addition to the assumptions made for BCC. In reality, where facilities are located and for whomever's waste they manage/ treat would be a matter of negotiation between BCC and MKC in the final contract preparations.

Residual Waste Treatment

Both BCC and MKC have requested a variety of technology combinations to be modelled in order to determine the 'technical' suitability to achieve the demands of LATS. In total some twelve combinations were put forward (Table 12). A brief summary of these technologies can be found in Appendix V.

Table 12: Technology combinations that have been modelled

1a	MBT + ATT + IVC	Mechanical Biological Treatment + Advanced Thermal Treatment of RDF + In-Vessel Composting of waste derived compost.
1b	MBT + FBG+ IVC	Mechanical Biological Treatment + Energy from Waste/ Fluidised Bed Gasifier + In-Vessel Composting of waste derived compost.
1c	MBT + IVC + Lf	Mechanical Biological Treatment + In-Vessel Composting of waste derived compost + Landfill
1d	MBT + IVC + RDF to 3rd Party	Mechanical Biological Treatment + In-Vessel Composting of waste derived compost + RDF treated in a third party thermal facility
2a	MT & AD + ATT	Mechanical Treatment + Advanced Thermal Treatment of RDF + Anaerobic Digestion of waste derived compost + maturation of digested compost product
2b	MT & AD + Lf	Mechanical Treatment + Anaerobic Digestion of waste derived compost and kerbside organics + Landfill
2c	MT & AD + RDF to 3rd Party	Mechanical Treatment + Anaerobic Digestion of waste derived compost and kerbside organics + RDF treated in a third party thermal facility
3a	ATT	Screening + Advanced Thermal Treatment
3b	ATT (Multi)	Screening + Advanced Thermal Treatment (Modules at multiple sites)
4	EfW	Screening + Energy from Waste recovery
5a	AC + ATT	Autoclave + Advanced Thermal Treatment
5b	AC + Lf	Autoclave + Landfill

Table 12 uses a number of acronyms and these are explained below in the brief descriptions of what each technology does in processing waste. A more detailed description of the technologies can also be found at Appendix V.

IVC – In-vessel Composting
In-vessel facilities are enclosed and so are able to compost a wider variety of waste due to increased control over environmental conditions and pests. This approach allows some kitchen waste and other putrescible materials to be composted into a good soil conditioner. IVC systems may be ABPR compliant.

MBT - Mechanical Biological Treatment
Residual waste is treated through a Mechanical Biological Treatment system, which dries the waste, degrading some organics, and then extracts out some recyclables (metals and possibly glass), compostable organics, and a refuse derived fuel for energy recovery. The RDF is combusted and energy potentially recovered in an Advanced Thermal Treatment process, such as gasification, pyrolysis either locally or in existing facilities. The compostable organics can be treated in an IVC facility, which also serves the kerbside collected organics. Without IVC the MBT plant would not be ABPR compliant.

MT - Mechanical Treatment and Anaerobic Digestion (AD)
Treating residual waste through a Mechanical Treatment system can:

- Remove bulky objects;
- Reduce the particle sizes of the waste;
- Extract out some recyclables i.e. metals;
- Produce a refuse derived fuel for energy recovery in an ATT or FBG facility, or co-fired in an existing facility, such as a cement kiln; and,
- Produce waste derived compostable organics for treatment in the AD facility.

Residual waste is initially through an integrated mechanical treatment system as described above. The waste derived compostable organics are treated in an Anaerobic Digestion facility, which is part of the integrated system with the mechanical treatment. This produces a waste derived compost suitable for land spreading for example, and a methane rich biogas which is combusted for electricity production on site. The AD process is ABPR (Animal Bi-Products Regulations) compliant, and hence is suitable for processing non-source segregated organics.

ATT - Advanced Thermal Treatment
Residual MSW waste is treated through an Advanced Thermal Treatment process, such as gasification or pyrolysis. This usually benefits from a pre-sorting/ screening process to remove bulky objects or shred the waste. These systems can be built on a modular scale, with a number of modules at a single site, or single modules built at multiple sites.

An ATT facility can also be configured to treat RDF. These also include pyrolysis and gasification. The output specification differs slightly from an ATT plant taking mixed MSW, as detailed in Appendix IV.

EfW - Energy from Waste
Energy from waste is the application of a sound proven combustion engineering principles to a variety of technologies which reduces the volume and quantity, and sanitise the municipal waste fraction, after recycling and composting has taken place, in order to recover energy from the input material. There are a variety of different technologies, for example, moving grate and mass burn, which can produce energy from waste by burning mixed MSW material, after an initial screening/ sorting process which remove large and oversize contraries. Metals are extracted after combustion has taken place, and bottom ash produced can be used as an aggregate. Fly ash produced is deemed hazardous, and whilst some markets exist for its use, it is generally landfilled.

FBG – Fluidised Bed Gasifier
A variation on traditional mass burn type EfW technology, this is a method of incineration in which combustion takes place on a fire bed composed of inert particles such as sand or ash. When air is blown through the bed, the material behaves as a fluid. When EfW proceeds an MBT plant in Europe it is likely to be a Fluidised Bed Gasification (FBG) technology, which can cope with the higher calorific values of RDF, compared to mixed MSW waste.

AC – Autoclave
Residual waste is treated through a series of interconnected steam conditioning autoclaves. These are pressure vessels that are similar to those used in hospitals to sterilise surgical instruments but are much larger and have unique patented characteristics. Unsorted household bagged waste is introduced directly into the vessels and steam and pressure is applied at over 140 degrees centigrade. A combination of the steam pressure, the rotation of the vessels and the internal helices results in the organic fraction of the waste being broken down into a fibrous lignocellulosic biomass; and the inorganics being sterilised and steam cleaned.

A series of technical assumptions used to generate the findings of the technologies modelled can be found in Appendix VI, and technology performance assumptions in Appendix VII.

4.3 Service Performance Modelling

The technology assessments have been conducted to provide objective interpretation of the capabilities of the technologies to deliver a certain level of performance. Three scenarios have been modelled: **Do Minimum**, **Meet Targets** and **Exceed Targets**, as per the guidance offered by the 4Ps in their model procurement contract toolkit.

Under the **Meet Targets** scenario the treatment technology is modelled to process the minimum amount of (post front-end) throughput required in order to comply with the LATS targets, plus a 10% buffer. **Meet Target** options 1 to 5 are denoted by the prefix **M**.

Under the **Exceed Targets** scenario the maximum amount of tonnage that could be processed through the treatment technology facilities is modelled. Thus, giving the best possible performance against LATS targets. This may for certain options generate a LATS buffer and the possibility of LATS permit trading. **Exceed Target** options 1 to 5 are denoted by the prefix **E**.

A further scenario to **Do Minimum** i.e. do what is only necessary to maintain the existing level of service was also modelled.[4]

These assessments are objective and impartial; they do not consider preference, planning or the wider criteria of choice. However, the final layer of assessment has considered the Capital Expenditure (CAPEX) and the Operational Expenditure (OPEX) of the technology combinations.

The performance in 2020 for **Meet Targets** (with a 10% buffer) and **Exceed Targets** for authorities together has been tabulated below. 2020 was chosen as this is the last Landfill Directive target year, and the year in which the smallest LATS allowance is set. It was assumed that the LATS allowances would remain at 2020 levels for the remainder of the contract.

[4] The 4Ps Waste management Procurement Pack (Part 2 – Section 2 – Developing the Outline Business Case) defines the Do Minimum scenario as "maintaining the status quo regarding the existing operational service – but including the minimum levels of investment necessary to halt the deterioration in service. In reality Authorities could only pursue this option if they chose to ignore statutory targets and rely exclusively on the purchase of permits to top up their landfill allowances. It therefore serves only as a theoretical benchmark and should not be regarded as a viable option.

Table 13: BCC LATS compliance and BVPI recycling performance in 2020 under **Meet Target** scenario

Options	Waste throughput	Front End recycling/ Composting	Recycling gained by Technology	Overall recycling/ composting	LATS (Shortfall/ Excess)	Tonnage landfilled
1a	91,120	50.5%	3.4%	53.9%	4,777	89,548
1b	91,523	50.5%	4.6%	55.1%	4,777	82,316
1c	136,750	50.5%	5.1%	55.6%	-261	111,935
1d	91,120	50.5%	3.4%	53.9%	4,777	82,655
2a	104,750	50.5%	7.9%	58.4%	4,777	104,535
2b	136,750	50.5%	11.6%	62.1%	-3,592	129,713
2c	104,750	50.5%	7.9%	58.4%	4,777	96,491
3	87,641	50.5%	2.7%	53.2%	4,777	87,127
3	87,641	50.5%	2.7%	53.2%	4,777	87,127
4	85,922	50.5%	0.6%	51.1%	4,777	85,063
5a	102,870	50.5%	4.7%	55.2%	4,777	74,571
5b	125,387	50.5%	6.5%	57.0%	-45,973	140,852

Table 14: BCC LATS compliance and BVPI recycling performance in 2020 under **Exceed Target** scenario

Options	Waste throughput	Front End recycling/ Composting	Recycling gained by Technology	Overall recycling/ composting	LATS (Shortfall/ Excess)	Tonnage landfilled
1a	136,750	50.5%	5.1%	55.6%	35,009	57,673
1b	136,750	50.5%	6.9%	57.4%	34,628	44,107
1c	136,750	50.5%	5.1%	55.6%	-261	111,935
1d	136,750	50.5%	5.1%	55.6%	35,009	44,107
2a	136,750	50.5%	11.6%	62.1%	23,714	87,703
2b	136,750	50.5%	11.6%	62.1%	-3,592	129,713
2c	136,750	50.5%	11.6%	62.1%	23,714	77,201
3	125,387	50.5%	3.9%	54.4%	30,957	55,898
3	125,387	50.5%	3.9%	54.4%	30,957	55,898
4	125,387	50.5%	0.9%	51.4%	32,612	124,134
5a	125,387	50.5%	6.5%	57.0%	18,705	72,931
5b	125,387	50.5%	6.5%	57.0%	-45,973	140,852

Table 15: MKC LATS compliance and BVPI recycling performance in 2020 under **Meet Target** scenario

Options	Waste throughput	Front End recycling/ Composting	Recycling gained by Technology	Overall recycling/ composting	LATS (Shortfall/ Excess	Tonnage landfilled
1a	78,400	45.7%	3.7%	49.4%	2,011	58,310
1b	78,741	45.7%	3.9%	49.6%	2,011	50,466
1c	98,795	45.7%	5.2%	50.9%	-10,464	81,388
1d	78,400	45.7%	3.7%	49.4%	2,011	50,746
2a	90,157	45.7%	10.0%	55.7%	2,011	69,041
2b	98,795	45.7%	12.0%	57.8%	-12,870	93,976
2c	90,091	45.7%	10.4%	56.1%	2,011	95,992
3	76,634	45.7%	3.1%	48.8%	2,011	53,501
3	76,634	45.7%	3.1%	48.8%	2,011	53,501
4	75,131	45.7%	0.5%	46.3%	2,011	72,341
5a	87,689	45.7%	6.4%	52.2%	1,609	55,730
5b	87,689	45.7%	6.4%	52.2%	-38,766	102,289

Table 16: MKC LATS compliance and BVPI recycling performance in 2020 under **Exceed Target** scenario

Options	Waste throughput	Front End recycling/ Composting	Recycling gained by Technology	Overall recycling/ composting	LATS (Shortfall/ Excess)	Tonnage landfilled
1a	98,795	45.7%	5.2%	50.9%	14,914	43,819
1b	98,795	45.7%	5.3%	51.1%	14,639	36,982
1c	98,795	45.7%	5.2%	50.9%	-10,567	83,020
1d	98,795	45.7%	5.2%	50.9%	14,914	34,018
2a	98,795	45.7%	12.0%	57.8%	6,754	65,514
2b	98,795	45.7%	12.0%	57.8%	-12,973	57,927
2c	98,795	45.7%	12.0%	57.8%	6,754	57,927
3a	87,689	45.7%	3.8%	49.5%	10,075	44,932
3b	87,689	45.7%	3.8%	49.5%	10,075	44,932
4	87,689	45.7%	0.7%	46.4%	11,232	86,813
5a	87,689	45.7%	10.3%	56.0%	1,507	56,845
5b	87,689	45.7%	6.4%	52.2%	-38,868	104,345

Table 17: BCC & MKC LATS compliance and BVPI recycling performance in 2020 under **Meet Target** scenario

Options	Waste throughput	Front End recycling/ Composting	Recycling gained by Technology	Overall recycling/ composting	LATS (Shortfall/ Excess)	Tonnage landfilled
1a	170,959	48.6%	3.8%	52.3%	6,789	148,706
1b	171,713	48.6%	5.1%	53.7%	6,789	131,434
1c	235,545	48.6%	5.2%	53.8%	-10,828	192,629
1d	170,959	48.6%	3.8%	52.3%	6,789	132,059
2a	192,874	48.6%	9.0%	57.6%	6,789	174,241
2b	235,545	48.6%	11.9%	60.4%	-16,565	222,891
2c	192,874	48.6%	9.0%	57.6%	6,789	159,701
3a	164,430	48.6%	3.2%	51.8%	6,789	140,294
3b	164,430	48.6%	3.2%	51.8%	6,789	140,294
4	161,206	48.6%	0.7%	49.2%	6,789	156,653
5a	189,623	48.6%	8.2%	56.8%	6,789	145,120
5b	213,077	48.6%	6.6%	55.1%	-52,815	242,271

Table 18: BCC & MKC LATS compliance and BVPI recycling performance in 2020 under **Exceed Target** scenario

Options	Waste throughput	Front End recycling/ Composting	Recycling gained by Technology	Overall recycling/ composting	LATS (Shortfall/ Excess)	Tonnage landfilled
1a	235,545	48.6%	5.2%	53.8%	49,924	101,491
1b	235,545	48.6%	7.0%	55.6%	49,267	78,125
1c	235,545	48.6%	5.2%	53.8%	-10,828	194,956
1d	235,545	48.6%	5.2%	53.8%	49,924	78,125
2a	235,545	48.6%	11.9%	60.4%	30,469	153,217
2b	235,545	48.6%	11.9%	60.4%	-16,565	225,577
2c	235,545	48.6%	11.9%	60.4%	30,469	135,127
3	213,077	48.6%	3.9%	52.5%	41,032	100,830
3	213,077	48.6%	3.9%	52.5%	41,032	100,830
4	213,077	48.6%	0.9%	49.4%	43,844	210,946
5a	213,077	48.6%	6.6%	55.1%	20,212	129,776
5b	213,077	48.6%	6.6%	55.1%	-52,815	245,197

Tables 13 to 18 illustrate that waste throughput varies both between and within the **Meet Targets** and **Exceed Targets** scenarios. As presented in Appendix VI, page A82, there is a maximum percentage throughput of residuals that any one technology arrangement can cope with, based on the processing capabilities and material input specifications needed, hence under the **Exceed Targets** options 3, 4 and 5 it is assumed that these technologies cannot cope with (bulky) HWRC/ CRC residues.

The variations in the **Meet Targets** scenario are attributable to the fact that different quantities of waste would have to be processed through each technology arrangement in order to meet the LATS target + 10%. This is because different technologies have different output specifications, as described in Appendix VI.

The generic mass balance performance of the different technologies is in Appendix VIII.

The tables underline that certain options, notably 1c, 2b and 5b, consistently fail to meet LATS targets. These are solutions that involve landfilling potentially usable/ treatable material. The fourth column shows that certain technology mixes yield a significant quantity of additional recycling/ composting performance through recovery of materials from the residual waste stream, particularly in option 2 using the integrated MT & AD technology mix.

4.4 Facility Sizing

Facilities have been sized according to those facilities/ technologies currently operational, or nearing the market (as proposed by bidders). A number of the technologies can be modular, for example, MBT, MT & AD, and ATT, where a number of modules may make up one facility i.e. at one site. Table 19 below summarises the thresholds for calculating the size of facilities required.

Table 19: thresholds for calculating the size of facilities required

Facility	One	Two or more
MRF	0 to < 60,000	60,000 to 120,000
IVC	0 to < 40,000	40,000 to 80,000
GWC	0 to < 15,000	15,000 to 30,000
MBT	0 to < 120,000	120,000 to 240,000
MT (& AD)	0 to < 120,000	120,000 to 240,000
ATT	0 to < 180,000	>180,000
ATT (multi)	0 to <60,000	>60,000
EfW (inc FBG)	0 to < 500,000	> 500,000

For BCC we have assumed one facility for each technology option. This does, however, take account of the fact that there may be more than one module operating at a single site. There are economies of scale in operating a number of modules at one site, keeping CAPEX and OPEX costs to a minimum and also in minimising planning and delivery risks. We have assumed two GWC facilities and one MRF.

For MKC we have also assumed one facility for each technology option. We have assumed one GWC facility and one MRF.

For BCC & MKC the tonnage throughput at facilities has increased and thus it was necessary for more than one facility to be constructed, this may or may not be at the same site, and would be dependent on factors and decisions beyond the remit of this report. The number of facilities needed can be seen in Appendix IX: Capital and Operational Cost Assumptions.

5 Capital and Operational Expenditure Assessment

The study so far has determined the performance (and short fall) of Front End Recycling Initiatives, and assessed a variety of treatment technology solutions that will enable the authorities of BCC and MKC to either **meet** (10% buffer) or **exceed** their respective LATS targets.

Whilst local Waste Strategy, BPEO and land use constraints will contribute to the final decision making
process, the overarching 'costs' of the assessed technology solutions will provide a useful means for either eliminating or including certain technology solutions.

Using confidential bidder's data, industry reports, market reports, and Environment Agency data, Jacobs Babtie have determined the OPEX and CAPEX of each facility, with the technologies being sized to cope with the maximum through put where relevant and split according to Table 19 at anyone time during the contract period.

CAPEX is the capital cost of the facility including construction but not land costs. OPEX is the operating cost of the facility.

The assessment has considered the net present value (NPV) of each of the twelve technology solutions;

- For meeting the LATS targets with a 10% buffer, the **Meet Targets** scenario;
- For exceeding the LATS targets (processing the maximum amount of waste that the facilities can accommodate), the **Exceed Targets** Scenario; and,
- Doing the minimum necessary to halt and deterioration in current service. This assumes zero technology and a dependence on the LATS (buying permits), the **Do Minimum** scenario.

Net Present Value (NPV)

NPV compares the value of a £ today versus the value of that same £ in the future, after taking inflation and return into account. This assumes that money values change with time because they are affected by interest rates i.e. £10 today has more value than £10 next year, and therefore in future years one would have to spend more to obtain the same value, or in this case to spend more to process the same quantity of waste. The NPVs shown, therefore, are the expenditure on specific options, adjusted back through the 24 year contract period to show the true £value in today's terms required to ensure the same level of value is achieved throughout the contract.

In the financial modelling undertaken by Jacobs Babtie the NPV includes all CAPEX, OPEX and revenues, and where necessary expenditure on permit buying.

It does **not** include and land purchase costs, any costs for permitting/ licensing or any the revised core discount rate, structural tax impacts and optimism bias associated with each of the funding options which would be modelled in the Public Sector Comparator and Value for Money analysis undertaken by Ernst & Young on the chosen reference project.

A 2.5% rate of interest has been assumed. Landfill has been modelled at 1% above this rate i.e. 3.5%, as explained in Appendix IX.

Under the **Do Minimum** scenario, treatment would be limited to that which was necessary to halt the deterioration of the service. This effectively meant treating the waste recovered by the WCAs, and that from bring banks and HWRCs/ CRCs. Therefore, the facilities modelled were the HWRCs, CRCs, Waste transfer station (WTS), Green Waste Composting (GWC) and IVC.

Under the **Meet Targets** scenario, the minimum amount of residual waste was processed in order to meet the landfill allowances allocated under the LATS plus a 10% buffer. The facilities were then sized according to the throughput required at contract end.

Under the **Exceed Targets** scenario all feasible residual waste was processed; this maximises the diversion of waste prior to landfill. Some minor wastes (such as HWRC/ CRC residues and fly-tipped waste) were excluded or limited, since they are unsuitable for further treatment in these types of processes as discussed in Appendix VI.

The CAPEX and OPEX assumptions have taken into account the modularity of certain technologies and the number required for BCC, MKC or BCC & MKC.

The results of the Capital Expenditure (CAPEX) and Operating Expenditure (OPEX) assessments are detailed in the tables and graphs below. Further details of the Capital and Operating costs are detailed in Appendix IX for each technology/ facility.

Appendix X details the NPV for landfill illustrating that the **Do Minimum** option is the least desirable in terms of the costs of landfilling. It further illustrates the costs of landfilling between the **Meet Targets** and **Exceed Targets** options.

A comparison of NPV (in £ million over the entire length of the contract) for technology options modelled for BCC, MKC and joint working is detailed in the Table below. It shows the NPV in £ millions, and furthermore, analyses that NPV as an average NPV per annum during the 24 year contract in £ million, and finally as an average NPV per tonne of MSW processed throughout the duration of the contact in £.

Table 20: Summary of net present values – BCC, MKC and joint working

BUCKINGHAMSHIRE					
		TECHNOLOGY OPTION	NPV £M	NPV £M pa	NPV £/t
1	DO-MIN	NONE	260	10.8	36.64
2	E1a	MBT + ATT + IVC	262	10.9	36.86
3	E1b	MBT + FBG + IVC	265	11.0	37.31
4	E1c	MBT + IVC + Lf	275	11.5	38.70
5	E1d	MBT + IVC + RDF to 3rd party	263	11.0	37.01
6	E2a	MT + ATT + AD	293	12.2	41.28
7	E2b	MT + AD + Lf	309	12.9	43.45
8	E2c	MT + AD + RDF to 3rd party	302	12.6	42.52
9	E3a	ATT	215	8.9	30.22
10	E3b	ATT (Multi)	243	10.1	34.24
11	E4	EfW	185	7.7	26.11
12	E5a	AC + ATT	258	10.7	36.32
13	E5b	AC + Lf	293	12.2	41.24
14	M1a	MBT + ATT + IVC	322	13.4	45.39
15	M1b	MBT + FBG + IVC	297	12.4	41.77
16	M1c	MBT + IVC + Lf	295	12.3	41.52
17	M1d	MBT + IVC + RDF to 3rd party	279	11.6	39.31
18	M2a	MT + ATT + AD	294	12.3	41.42
19	M2b	MT + AD + Lf	306	12.8	43.09
20	M2c	MT + AD + RDF to 3rd party	295	12.3	41.53
21	M3a	ATT	248	10.3	34.87
22	M3b	ATT (Multi)	265	11.0	37.32
23	M4	EfW	225	9.4	31.74
24	M5a	AC + ATT	267	11.1	37.56
25	M5b	AC + Lf	293	12.2	41.24

MILTON KEYNES					
		TECHNOLOGY OPTION	NPV £M	NPV £M pa	NPV £/t
1	DO-MIN	NONE	170	7.1	38.65
2	E1a	MBT + ATT + IVC	192	8.0	43.67
3	E1b	MBT + FBG + IVC	190	7.9	43.24
4	E1c	MBT + IVC + Lf	193	8.1	43.90
5	E1d	MBT + IVC + RDF to 3rd party	182	7.6	41.35
6	E2a	MT + ATT + AD	214	8.9	48.53
7	E2b	MT + AD + Lf	177	7.4	40.28
8	E2c	MT + AD + RDF to 3rd party	208	8.7	47.26
9	E3a	ATT	153	6.4	34.67
10	E3b	ATT (Multi)	172	7.1	38.97
11	E4	EfW	130	5.4	29.56
12	E5a	AC + ATT	189	7.9	43.01
13	E5b	AC + Lf	200	8.4	45.53
14	M1a	MBT + ATT + IVC	232	9.7	52.71
15	M1b	MBT + FBG + IVC	207	8.6	46.99
16	M1c	MBT + IVC + Lf	193	8.0	43.81
17	M1d	MBT + IVC + RDF to 3rd party	201	8.4	45.65
18	M2a	MT + ATT + AD	213	8.9	48.33
19	M2b	MT + AD + Lf	209	8.7	47.46
20	M2c	MT + AD + RDF to 3rd party	235	9.8	53.42
21	M3a	ATT	160	6.6	36.24
22	M3b	ATT (Multi)	181	7.5	41.06
23	M4	EfW	143	6.0	32.51
24	M5a	AC + ATT	190	7.9	43.26
25	M5b	AC + Lf	200	8.3	45.51

BUCKINGHAMSHIRE AND MILTON KEYNES					
		TECHNOLOGY OPTION	NPV £M	NPV £M pa	NPV £/t
1	DO-MIN	NONE	403	16.8	35.06
2	E1a	MBT + ATT + IVC	428	17.8	37.24
3	E1b	MBT + FBG + IVC	433	18.0	37.65
4	E1c	MBT + IVC + Lf	476	19.8	41.39
5	E1d	MBT + IVC + RDF to 3rd party	423	17.6	36.74
6	E2a	MT + ATT + AD	465	19.4	40.46
7	E2b	MT + AD + Lf	492	20.5	42.73
8	E2c	MT + AD + RDF to 3rd party	483	20.1	41.98
9	E3a	ATT	372	15.5	32.35
10	E3b	ATT (Multi)	384	16.0	33.37
11	E4	EfW	292	12.2	25.37
12	E5a	AC + ATT	433	18.0	37.64
13	E5b	AC + Lf	485	20.2	42.17
14	M1a	MBT + ATT + IVC	501	20.9	43.58
15	M1b	MBT + FBG + IVC	494	20.6	42.91
16	M1c	MBT + IVC + Lf	476	19.8	41.37
17	M1d	MBT + IVC + RDF to 3rd party	517	21.6	44.97
18	M2a	MT + ATT + AD	506	21.1	43.98
19	M2b	MT + AD + Lf	491	20.5	42.69
20	M2c	MT + AD + RDF to 3rd party	501	20.9	43.52
21	M3a	ATT	387	16.1	33.66
22	M3b	ATT (Multi)	436	18.2	37.89
23	M4	EfW	355	14.8	30.87
24	M5a	AC + ATT	446	18.6	38.75
25	M5b	AC + Lf	485	20.2	42.17

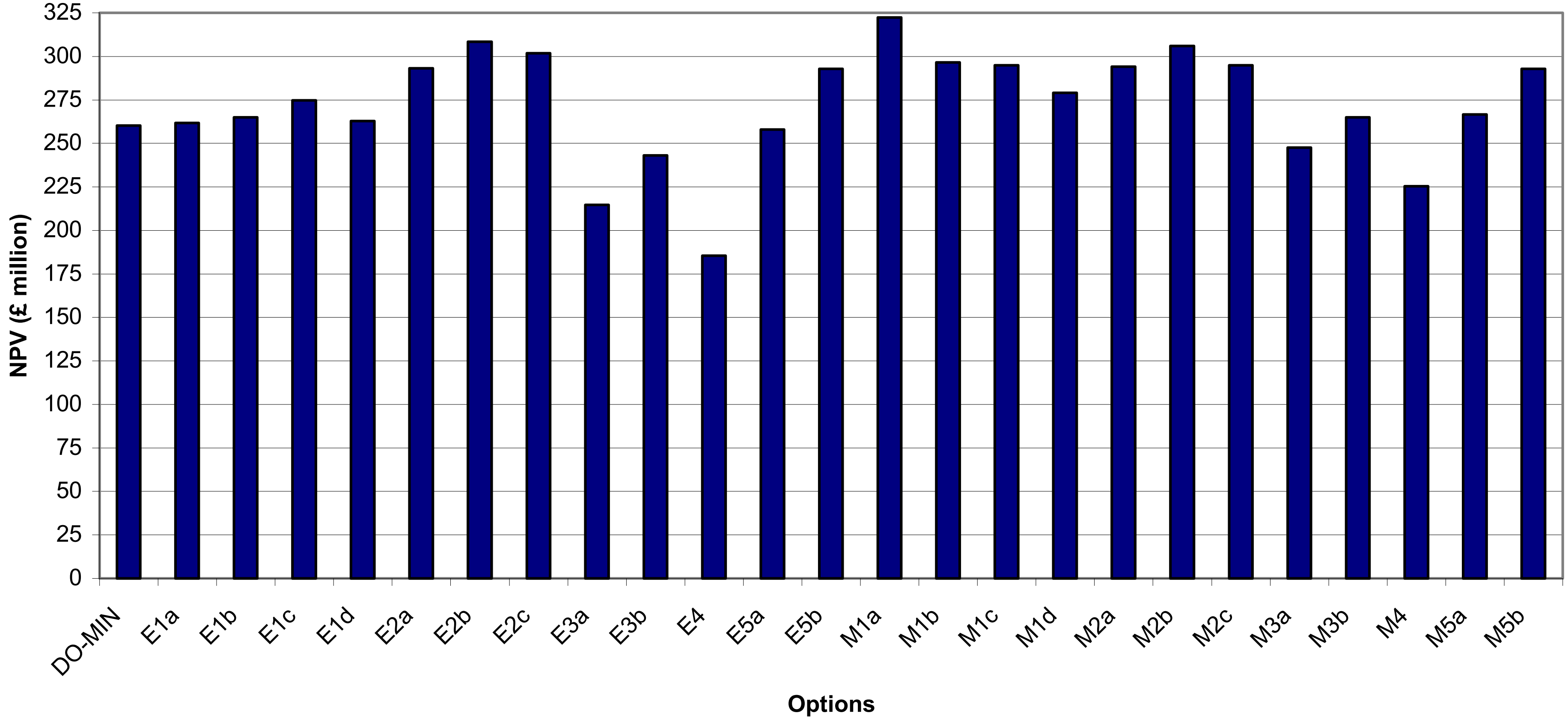
Please note that the NPV £/t should not be considered as a prospective gate fee.

The E prefix in technology options relates to **Exceed Targets** options. The M prefix in technology options relates to **Meet Targets** options
The acronyms used in the Table above are expanded and described in the Table below.

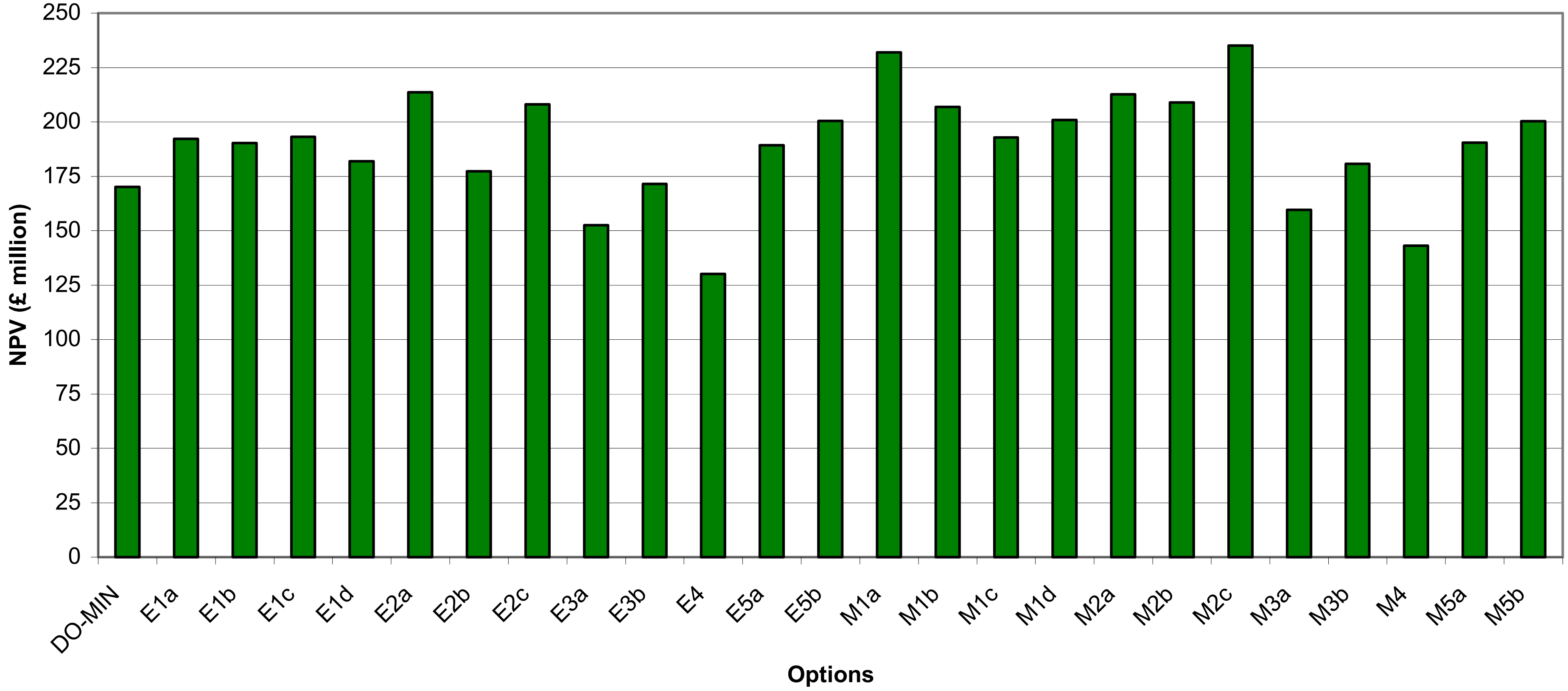
Table 21: Description of technology options

Option	Technology Acronyms	Technology Descriptions
1a	MBT + ATT + IVC	Mechanical Biological Treatment + Advanced Thermal Treatment of RDF + In-Vessel Composting of waste derived compost.
1b	MBT + EFW/FBG + IVC	Mechanical Biological Treatment + Fluidised Bed Gasifier (EfW) + In-Vessel Composting of waste derived compost
1c	MBT + IVC + Lf	Mechanical Biological Treatment + In-Vessel Composting of waste derived compost + Landfill
1d	MBT + IVC + RDF to 3rd party	Mechanical Biological Treatment + In-Vessel Composting of waste derived compost + RDF to 3rd party
2a	MT + ATT + AD	Mechanical Treatment + Advanced Thermal Treatment of RDF + Anaerobic Digestion of waste derived compost + maturation of digested compost product
2b	MT + AD + Lf	Mechanical Treatment + Anaerobic Digestion of waste derived compost and kerbside organics + Landfill
2c	MT + AD + RDF to 3rd party	Mechanical Treatment + Anaerobic Digestion of waste derived compost and kerbside organics + RDF to 3rd party
3a	ATT	Screening + Advanced Thermal Treatment
3b	ATT (Multi)	Screening + Advanced Thermal Treatment (multiple sites)
4	EfW	Screening + Energy from Waste recovery
5a	AC + ATT	Autoclave + Advanced Thermal Treatment
5b	AC + Lf	Autoclave + Landfill

A comparison of NPVs for technology options modelled for BCC is presented in the figure below.
Graph 6: A comparison of NPVs for all **Meet** and **Exceed** (LATS) **Target** options and against the **Do Minimum** option for BCC.

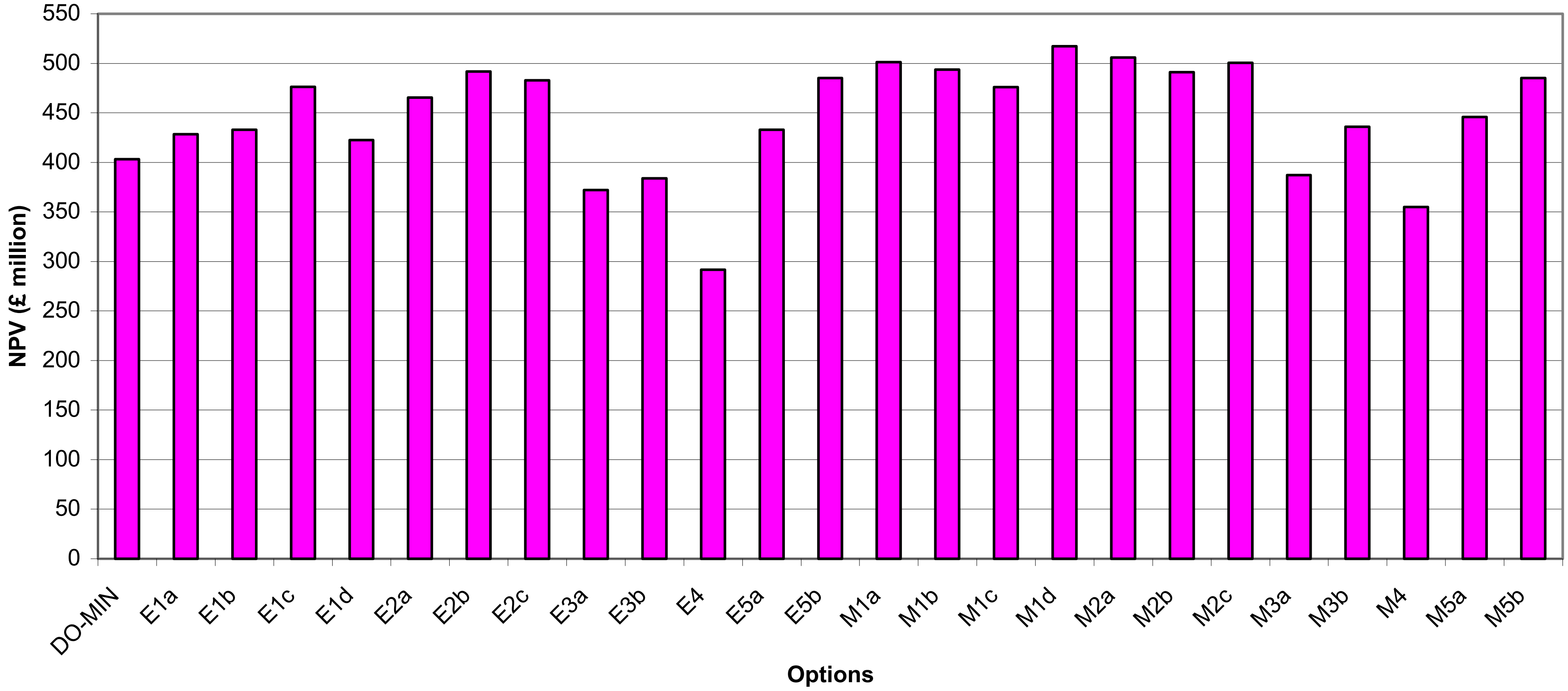


A comparison of NPVs for technology options modelled for MKC is presented in the figure below.
Graph 7: A comparison of NPVs for all **Meet** and **Exceed** (LATS) **Target** options and against the **Do Minimum** option for MKC



A comparison of NPVs for technology options modelled for BCC & MKC is presented in the figure below.

Graph 8: A comparison of NPVs for all **Meet** and **Exceed** (LATS) **Target** options and against the **Do Minimum** option for BCC & MKC



6 Conclusions

The Options Appraisal Study is a twofold exercise;

Firstly, a technical appraisal of waste management treatment options that will improve the existing waste management performance of a public authority; and, Secondly, to financially appraise the preferred technical option.

This report focuses upon the first stage of the Options Appraisal process.

The report has considered three key aspects of the individual and combined efforts of BCC and MKC:

1. Front End Recycling;
2. The application of twelve different technological solutions to achieve LATS; and,
3. The CAPEX and OPEX Costs of the twelve technological solutions.

The Front End Recycling modelling process has considered;

- Waste composition;
- Waste growth;
- Waste minimisation;
- Population growth;
- Waste arisings; and,
- Currently 'planned' initiatives for improvement.

The Front End Recycling performance (against BVPIs and agreed recycling targets) has been measured. Three levels of targets were considered, low, medium and high. The results indicate that if both BCC and its districts, and MKC continue to manage their MSW without additional initiatives, both authorities would fail recycling/ composting targets.

In order to combat the failure of recycling targets a series of additional initiatives were proposed to optimise the performance of Front End Recycling. The results of the optimisation process were positive, in that all targets were met with the exception of MKC failing the 2020 high target.

The Front End Recycling modelling exercise has demonstrated that recycling rates of circa 45% to 50% are certainly achievable, however, the capital and operational finance for increased initiatives has yet to be confirmed by either BCC or MKC. Furthermore in the case of BCC the operational and consequent quality control of any additional operational contracts would need to be considered. The importance of agreeing a Memorandum of Understanding between the WCAs and BCC is vital in terms of the outlining a specification i.e. composition of input materials. Moreover, it will be paramount that levels of front end performance are agreed with any contractor so that performance risk and input specification risk are minimised.

The primary purpose of Front End Recycling is to attain certain statutory targets, however, and perhaps of more importance is the fact that the method and performance of Front End Recycling prescribes the quality and quantity of residual waste that will be treated by either one or a combination of technologies.

6.1 LATS

The EU Landfill directive requires member nations to progressively reduce the amount of BMW sent to landfill over the next 15 years. In the UK the performance of authorities is policed by

LATS. Whilst Front End Recycling contributes to reducing BMW to Landfill, it does not divert the amount of BMW required to comply with LATS.

The residual waste therefore requires further treatment to ensure that authorities meet their prescribed BMW landfill allowance.

The previous chapters have considered the quantities of residual waste that will require treatment in order for both BCC and MKC to comply with LATS. To consider the economies of scale associated with the investment required for treatment facilities, two levels of LATS performance were considered as recommended by the 4Ps guidance;

- Meeting LATS targets with a 10% buffer i.e. **Meet Targets**; and,
- Exceeding LATS (processing all practicable residual waste) i.e. **Exceed Targets**.

The performance of the technology combinations has been modelled to establish compliance with both meeting and exceeding LATS. Three technology combinations failed to comply with LATS;

- Autoclaving and Landfill of products;
- MBT and In Vessel Composting with RDF and residues to Landfill; and,
- MT and Anaerobic Digestion with RDF and residues to Landfill.

Table 23: Technology Arrangements that either exceed or meet with LATS up to 2020.

Ref:	Technology Arrangement	LATS Compliance					
		Meets LATS			Exceeds LATS		
		BCC	MKC	JW	BCC	MKC	JW
1a	Mechanical Biological Treatment + Advanced Thermal Treatment of RDF + In-Vessel Composting of waste derived compost.	✓	✓	✓	✓	✓	✓
1b	Mechanical Biological Treatment + Energy from Waste/ Fluidised Bed Gasifier + In-Vessel Composting of waste derived compost.	✓	✓	✓	✓	✓	✓
1c	Mechanical Biological Treatment + In-Vessel Composting of waste derived compost + Landfill	✗	✗	✗	✗	✗	✗
1d	Mechanical Biological Treatment + In-Vessel Composting of waste derived compost + RDF treated in a third party thermal facility	✓	✓	✓	✓	✓	✓
2a	Mechanical Treatment + Advanced Thermal Treatment of RDF + Anaerobic Digestion of waste derived compost + maturation of digested compost product	✓	✓	✓	✓	✓	✓
2b	Mechanical Treatment + Anaerobic Digestion of waste derived compost and kerbside organics + Landfill	✗	✗	✗	✗	✗	✗
2c	Mechanical Treatment + Anaerobic Digestion of waste derived compost and kerbside organics + RDF treated in a third party thermal facility	✓	✓	✓	✓	✓	✓
3a	Screening + Advanced Thermal Treatment	✓	✓	✓	✓	✓	✓
3b	Screening + Advanced Thermal Treatment (multiple facilities)	✓	✓	✓	✓	✓	✓
4	Screening + Energy from Waste recovery	✓	✓	✓	✓	✓	✓
5a	Autoclave + Advanced Thermal Treatment	✓	✓	✓	✓	✓	✓
5b	Autoclave + Landfill	✗	✗	✗	✗	✗	✗

For details on how much options meet, exceed or shortfall against LATS targets please refer to Tables 13 to 18

6.2 Technology Choice

The over arching purpose of this stage of the options appraisal has been to provide the authorities of BCC and MKC with a series of assessments. The results of the assessments have provided the information required upon which a decision can be made as to what is the best arrangement of Front End Recycling and Residual Waste Treatment in terms of performance and value for money.

As previously stated (in this report) technical performance and value for money are only two of several criteria normally used to make a final decision. Other such criteria typically include, local waste strategic policy, BPEO assessment and politics. Notwithstanding, certain technological solutions are evidently more favourable than others. Excluding the additional criteria there are technological solutions that 'stand out' from the other solutions as demonstrating greater VFM and performance.

6.3 BVPIs, LATS and VFM

The three criteria that have been used in this study [BVPIs, LATS and VFM) have allowed comparisons of performance and value to be made.

VFM - Table 20 provides a full comparison of NPVs for all eleven technology arrangements; the Table compares independent and joint working. From this Table the top three performing technologies in terms of Value For Money all involve some form of thermal treatment.

Performance - Tables 13 to 18 compare the recycling gained and the potential LATS performance by treatment technologies. Considering the LATS and Recycling performance of the scenarios where maximum LATS performance is aimed for then the best treatment solutions differ from those identified in terms of NPV.

6.4 Further Choice Criteria - Risk

Without considering criteria beyond VFM and performance it will prove to be very difficult to determine the most suitable solution for BCC, MKC or Joint Working. The better the VFM the more likely that thermal treatment will feature in the mix of technology. The best VFM solution that does not include thermal treatment is the **Do Minimum** scenario, where it is assumed that landfill allowance permits will be purchased from other authorities. This scenario has considered permits trading at £30 per tonne, whilst in line with the 4Ps guidance industry believes that this is an extremely optimistic value, hence sensitivity tests were conducted at £40 and £70 per tonne for options landfilling RDF.

Assuming a satisfactory balance between VFM and performance can be established, there are a series of risks that need to be considered which apply to each component of every technological arrangement. Typically the following risks (though not exhaustive) should be considered:

Design Risk	Construction Risk	Planning Risk	Operational Risk
Residual Value Risk	Financial Risk	Performance Risk	Demand Risk
Technology Risk	Regulatory Risk	Taxation Risk	Insurance Risk

Although some of these risks have been considered i.e. performance risk, and some will be addressed in the next stage of the options appraisal, several will need to be considered in order to make an informed decision as to what is the best solution for BCC and MKC either independently or for joint working.

6.5 The Risk Decision Trees

A series of risk flow diagrams (Risk Decision Trees) have been produced for each technology option and whilst these are presented in a separate booklet for ease of read, they are an integral part of this report. They have been designed to assist in tracking the risks associated with each stage of the treatment technology arrangements.

To keep the flow diagrams manageable, the risks have been referred to by short titles. These are defined below in 6.5.1 to 6.5.7.

6.5.1 Input Specification

This may take the form of organic content (typical for MBT, AD and composting), and the organic content may be further refined to specific organic type. It may also include calorific value (CV), and will exclude contaminants, pollutants (batteries) and so on.

For MRF and recycling activities it will include recyclate percentages on the basis that you can't recycle what's not there.

Where collection is a separate activity such as for the County Council, this is very difficult to manage against a tight specification. Integrating collection helps to a degree.
Where several processes interact, such as MBT followed by other treatments, thermal or compost, the risk for the secondary process can pass back to become part of the input spec for the primary process.

6.5.2 Supplier Robustness

Even where the performance risks have been accepted by the technology supplier, many new technology companies are not robust and their ability to respond to failure and pay penalties, will be severely limited. They will represent a financing risk, as Banks are unlikely to provide funding, and a deliverability risk as they may simply go bankrupt when failure occurs, leaving the Council with no redress.

6.5.3 Financability

Related to robustness, this represents two areas of risk. The Authority may make considerable progress with a favoured supplier to find that, on preferred bidder award, they cannot raise the necessary finance.

The second is that, a bank may significantly change the project agreement and risk profile in return for providing finance; and the Authority becomes the technology guarantor.

6.5.4 End Market

The markets for recyclate, compost and RDF are uncertain and do not provide off take guarantees for as long as the waste contract.

The risks this presents the Authority with are:

- An increase in gate fee to make up income shortfalls
- Failure of the LATS and other targets
- Escalating gate fees as the cost of RDF disposal follows increases in landfill tax
- Contract default

Contractors are unwilling to accept this risk to any great degree and, particularly for compost and RDF, will mitigate the risk by tightening the input specification (see above).

6.5.5 Planning

This risk is common to all waste facilities but significant for any thermal treatments. Contractors will not reach financial close without planning and will seek costs to appeal 'political' refusal. The risk here is delay and cost with uncertainty of outcome. Moreover, there is risk with obtaining licenses for ABPR compliance, and IPPC may also be necessary on larger scale facilities.

6.5.6 Availability

This applies to landfill in particular, as the availability will decline over the period of any new contract. Any risk that may rely on local landfill or where a contractor offers a capped price for landfill during failure period needs to be treated with caution.

6.5.7 ABPR compliance

Output from mixed compost will need to be ABPR compliant. This is an uncertain and difficult area and Contractors will attempt to make any failure a result of input specification failure.

6.5.8 Risk Management:

The risks described all relate to the technological solutions explored thus far. Managing the risks associated with the technological solutions (or component parts) is not straightforward. The Authority can take a view on the input specification but needs to bear in mind the impact on existing or future front-end activities (recycling, home composting etc).

Through careful contractual arrangements it may be possible to transfer some of the risks to the contractor, however, the contractor (or their financiers) will seek to minimise any potential risk exposure, typically through financial security by costing the risk into the gate fee.

6.6 Risk summary tables

The key risk issues identified for each technology option in the risk trees are explored further in this section, with a view to producing summary risk tables for each technology option.

A risk register was drawn up using key risk issues at the pre- and post- preferred bidder stage of the procurement process. The risk headings identified above in 6.8.1 to 6.8.8 are the salient issues that need to be addressed in assessing the risks associated with each technology. There are numerous other risk areas, however, that would need to be addressed in a full and comprehensive risk assessment and key risk areas were identified in the table in 6.7 above. These have been expanded upon and structured according to pre- and post- preferred bidder stage, as outlined below in the risk register.

Pre-Preferred Bidder Stage:

Market Interest Risk	The risk of attracting suitable bidders to bid for either two separate single contracts and/ or a joint working contract? Is waste in BCC and MKC attractive to the market?
Supplier Robustness i.e. financial risk	The risk that the supplier has and a good track record and experience with the technologies and the waste streams to be processed? Do they have suitable financial backing/ provision? The risk that, the Contractor fails to raise sufficient finance to deliver the project or the cost of finance is higher or lower than predicted.
Technology Risk	The risk of unexpected change in the technology employed, which leads to reconfiguration or obsolescence of existing assets.
Input Specification	The risk of whether the technology is flexible enough to cope with changes in waste composition, waste quantity, waste quality? Is equipment down time for any reconfiguration minimised?
ABPR compliance	Compostable material derived from processing non-source segregated organic waste, any kitchen waste collected, and/or any green waste collected at source that is mixed with kitchen waste must be processed through an ABPR compliant process. Difficult and lengthy process to demonstrate compliance with the EA and obtain relevant permits/ license.
End Market Risk	The risk that, material quality, fluctuation in market price, and fluctuation in market demand affect revenue, and force material to be landfilled.
Performance Risk	The risk that the Contractor fails to meet its performance targets and Council targets are therefore missed as a result.
Operational Risk	The risk that operating costs are higher or even lower than forecast
Planning Risk	The risk that the Contractor fails to achieve planning approval which results in a failure to achieve contract targets for recycling, increased costs or a failure to deliver facilities to the agreed timetable

Post Preferred Bidder Stage:

Regulatory Risk The risk that, a change in law results in increased costs.

Taxation Risk The risk that a change in VAT or corporate tax results in increased costs.

Insurance Risk The risk of unavailability of insurance or increases in insurance premiums.

Residual Value Risk The risk that the asset value/transfer at contract expiry is not as conceived at contract signature.

Design Risk The risk that the Contractor's solution is flawed such that the Contractor fails to achieve the contract targets or bears additional costs.

Construction Risk The risk that the costs of facilities and assets are higher than expected or takes longer to build.

Political Risk The risk that the political background and the political systems in BCC and MKC are likely to increase any of the risks outlined above?

The risks that need to be considered for this options appraisal report are those at pre-preferred bidder stage. It is critical to note that the probability and consequences of impacts and the resulting risk will, and does, differ between BCC, MKC and if BCC & MKC pursue joint working.

Each technology option is considered in detail and assigned a risk rating based on a simple 3 by 3 risk matrix that has been developed at this stage of the options appraisal and this is outlined below.

IMPACT	High	**Significant**	**Critical**	**Unacceptable**
	Medium	**Insignificant**	**Significant**	**Critical**
	Low	**Acceptable**	**Insignificant**	**Significant**
		Low	Medium	High
		PROBABILITY		

The summary risk tables for each technology option are provided below. They apply the five risk assessment options outlined in the risk matrix above and detail n/a where an assessment of risk is not applicable.

1a: MBT + ATT + IVC	MBT	ATT	IVC
Market Interest Risk	Significant	Significant	Acceptable
Supplier Robustness/ financial risk	Critical	Critical	Acceptable
Technology Risk	Critical	Significant	Acceptable
Input Specification	Critical	Significant	Critical
ABPR compliance	n/a	n/a	Critical
End Market Risk	Significant	Insignificant	Critical
Performance Risk	Insignificant	Insignificant	Significant
Operational Risk	Significant	Significant	Significant
Planning Risk	Significant	Critical	Significant

1b: MBT + EFW/FBG + IVC	MBT	FBG	IVC
Market Interest Risk	Significant	Insignificant	Acceptable
Supplier Robustness/ financial risk	Critical	Insignificant	Acceptable
Technology Risk	Critical	Insignificant	Acceptable
Input Specification	Critical	Significant	Critical
ABPR compliance	n/a	n/a	Critical
End Market Risk	Significant	Insignificant	Critical
Performance Risk	Insignificant	Insignificant	Significant
Operational Risk	Significant	Significant	Significant
Planning Risk	Significant	Critical	Significant

1c: MBT + IVC + Lf	MBT	IVC	Lf
Market Interest Risk	Significant	Acceptable	Insignificant
Supplier Robustness/ financial risk	Critical	Acceptable	Insignificant
Technology Risk	Critical	Acceptable	Acceptable
Input Specification	Critical	Critical	Acceptable
ABPR compliance	n/a	Critical	n/a
End Market Risk	Significant	Critical	n/a
Performance Risk	Insignificant	Significant	Significant
Operational Risk	Significant	Significant	Insignificant
Planning Risk	Significant	Significant	Critical

1d: MBT + IVC + RDF to 3rd party	MBT	IVC	RDF to 3rd party
Market Interest Risk	Significant	Acceptable	Critical
Supplier Robustness/ financial risk	Critical	Acceptable	Significant
Technology Risk	Critical	Acceptable	Significant
Input Specification	Critical	Critical	Insignificant
ABPR compliance	n/a	Critical	n/a
End Market Risk	Significant	Critical	Acceptable
Performance Risk	Insignificant	Significant	Insignificant
Operational Risk	Significant	Significant	Significant
Planning Risk	Significant	Significant	n/a

2a: MT + ATT + AD	MT	ATT	AD
Market Interest Risk	Significant	Significant	Significant
Supplier Robustness/ financial risk	Significant	Critical	Significant
Technology Risk	Insignificant	Significant	Insignificant
Input Specification	Insignificant	Significant	Critical
ABPR compliance	n/a	n/a	Significant
End Market Risk	Critical	Insignificant	Critical
Performance Risk	Significant	Insignificant	Critical
Operational Risk	Significant	Significant	Significant
Planning Risk	Significant	Critical	Significant

2b: MT + AD + Lf	MT	AD	Lf
Market Interest Risk	Significant	Significant	Insignificant
Supplier Robustness/ financial risk	Significant	Significant	Insignificant
Technology Risk	Insignificant	Insignificant	Acceptable
Input Specification	Insignificant	Critical	Acceptable
ABPR compliance	n/a	Significant	n/a
End Market Risk	Critical	Critical	n/a
Performance Risk	Significant	Critical	Significant
Operational Risk	Significant	Significant	Insignificant
Planning Risk	Significant	Significant	Critical

2c: MT + AD + RDF to 3rd party	MT	AD	RDF to 3rd party
Market Interest Risk	Significant	Significant	Critical
Supplier Robustness/ financial risk	Significant	Significant	Significant
Technology Risk	Insignificant	Insignificant	Significant
Input Specification	Insignificant	Critical	Insignificant
ABPR compliance	n/a	Significant	n/a
End Market Risk	Critical	Critical	Acceptable
Performance Risk	Significant	Critical	Insignificant
Operational Risk	Significant	Significant	Significant
Planning Risk	Significant	Significant	n/a

3a: ATT	ATT
Market Interest Risk	Significant
Supplier Robustness/ financial risk	Significant
Technology Risk	Significant
Input Specification	Insignificant
ABPR compliance	n/a
End Market Risk	Insignificant
Performance Risk	Significant
Operational Risk	Significant
Planning Risk	Critical

3b: ATT (Multi)	ATT (Multi)
Market Interest Risk	Significant
Supplier Robustness/ financial risk	Critical
Technology Risk	Significant
Input Specification	Insignificant
ABPR compliance	n/a
End Market Risk	Insignificant
Performance Risk	Significant
Operational Risk	Critical
Planning Risk	Critical

4: EfW	EfW
Market Interest Risk	Acceptable
Supplier Robustness/ financial risk	Acceptable
Technology Risk	Acceptable
Input Specification	Acceptable
ABPR compliance	n/a
End Market Risk	Insignificant
Performance Risk	Insignificant
Operational Risk	Insignificant
Planning Risk	Critical

5a: AC + ATT	AC	ATT
Market Interest Risk	Critical	Significant
Supplier Robustness/ financial risk	Critical	Critical
Technology Risk	Critical	Significant
Input Specification	Significant	Significant
ABPR compliance	n/a	n/a
End Market Risk	Critical	Insignificant
Performance Risk	Critical	Insignificant
Operational Risk	Critical	Significant
Planning Risk	Significant	Critical

5b: Ac + Lf	AC	Lf
Market Interest Risk	Critical	Insignificant
Supplier Robustness/ financial risk	Critical	Insignificant
Technology Risk	Critical	Acceptable
Input Specification	Significant	Acceptable
ABPR compliance	n/a	n/a
End Market Risk	Critical	n/a
Performance Risk	Critical	Significant
Operational Risk	Critical	Insignificant
Planning Risk	Significant	Critical

6.7 Risk Management

In assessing the risk represented by technology and treatment options the salient principle the Authority needs to keep in mind is the result of failure of the treatment.

If the failure cannot be left with the Contractor, the Authority will be liable for some or all of the following:

1. The continued unitary payment to the contractor.

   If the failure is the result of the waste delivered not complying with the input specification (see below), then the Contractor will require continued payment of the gate fee, even if the facility is not operating.

2. The cost of landfill disposal – at whatever the rate is at the time.

3. The cost of landfill tax at whatever the rate is at the time.

4. The cost of any penalties or LATS allowance purchases to meet the LATS targets from 2005/06 onwards, at whatever the rate is during that period. This would encompass any costs for arbitration, and the indirect costs on the damage to the Councils' reputations.

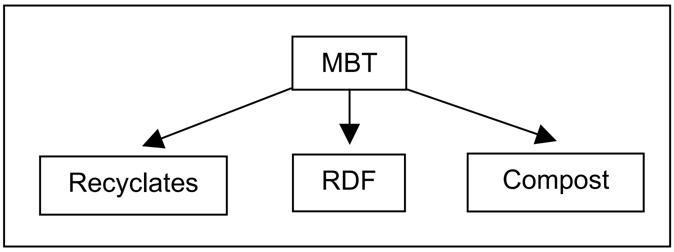
The technology supplier, particularly for new technology or unproven treatments, will require a very tight input specification. Clearly, however, the tighter the input specification, the greater the risk of performance failure.

Funding bodies, such as banks will impose very tight specifications even if the Contractor is confident of his process.

The more upstream activity (household separation, producer responsibility impacts, minimisation etc) the less predictable the waste stream for treatment is.

6.7.1 Risk Ownership Example

A typical technological arrangement for the treatment of residual waste is:



The RDF fraction accounts for approximately 40% of the input tonnage and therefore represents a significant risk. The RDF cannot be landfilled without paying landfill tax (or additional charge dependent upon the infrastructure that the contractor has) and will significantly reduce overall BMW diversion. The manufacturers of MBT equipment correctly describe the RDF as a useable fuel, they do not guarantee a commercial value, simply that if the correct input specification is adhered to then the RDF will provide a typical CV. Therefore, it would be prudent to determine a use for the RDF before generating it. In the UK there are little on no established markets or consumers for RDF. Notwithstanding MBT is currently a favoured option for MSW residual treatment. Potential outlets include Cement Kilns, Power Stations and existing EfW plants.

It is of particular note that there are significant drawbacks in relying on the cement kiln market. A report by Fichtner Consulting Engineers[5] suggested that UK cement kiln capacity for RDF was approximately 350,000 tonnes in the medium term (2013), which in no way addresses the potential 3.4 million tonnes of RDF that is predicted to be being produced at that time. Existing power stations would have to become compliant with the onerous demands of the Waste Incineration Directive for co-incineration. Fichtner concluded that there is virtually no prospect of this outlet before 2016. Existing EfW plants cope with the high calorific value of RDF and would therefore have to mix it with additional MSW feedstock to reduce the temperature, therein defeating the point of producing RDF. There is limited gasification technology capacity or indeed dedicated RDF-fired technology capacity in the UK.

The fuel currently attracts little or no market value. There is a haulage charge to consider and an end-user 'gate fee'.

How can the RDF risk be managed?

- Do not create it – by choosing an alternative technology that does generate RDF is the only true method of risk elimination.
- Create an outlet – by choosing a technology arrangement that includes a use for RDF i.e. ATT or FBG, although these attract their risks too.

The nature of these risks leads to a choice based on the following:

- A robust, experienced technology supplier, for example, EfW, MT & AD;
- A wide and flexible input specification, for example, EfW, FBG, MBT, MT, and ATT (as a stand alone facility); and,
- A product with an existing long-term market, for example, EfW bottom ash aggregates, MT and MBT metals extraction.

Assuming the need for thermal treatment to feature in the technology mix, the initial decision process of which form of thermal treatment to pursue should take into account the associated risks.

- Energy from Waste (including CHP)
  - **Planning Permission**
  - **Public Acceptance**
- Mechanical Biological Treatment and Fluidised Bed Gasifier
  - **Technology Compatibility**
  - **Planning Permission**
  - **Input Specification**

[5] Fichtner Consulting Engineers (2004). RDF Opportunities: Coal and Cement Industries. RRF.

- Mechanical Biological Treatment and Advanced Thermal Treatment

  - **Financability**
  - **Technology Compatibility**
  - **Planning Permission**

7 Recommendations

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7.1 Front End Recycling

The front end recycling assessments have concluded that both authorities (Buckinghamshire and Milton Keynes) will need to "optimise" their respective Front End Recycling programmes in order to achieve the recycling and composting targets that have been agreed (Table 1. Page 10). The pre-treatment recycling performance for BCC and MKC is 50.5% and 45.7% respectively. The additional recycling performance gained from technology treatments ranges from 3% to 12% (figures rounded) and whilst recycling performance is a pre requisite for attracting PFI credits, the performance of the authorities is not significantly effected whether they choose to work together or independently.

7.2 LATS

Of the twelve technology arrangements modelled three fail to divert a sufficient amount of BMW required for the authorities to meet their respective LATS targets. Of the remaining nine arrangements all successfully achieve LATS targets whether the authorities choose to work together or independently.

7.3 VFM

The targets (BVPIs and LATS) are generally not affected by separate or joint working arrangements. Each authority is required to comply with targets and working separately or together does not increase or decrease the performance of either front end recycling or treatment technologies. The first evidence that there may be some benefit in working together is realised when considering the financial and practical aspects of residual waste treatment.

The VFM assessments considering the capital and operational expenditure typically conform to the economies of scale associated with bulk processing, the greater the throughput the lower the unit price.

The increased thought put is apportioned to the combined tonnages of both authorities, this aspect of joint working is further enhanced by the preference of DEFRA to award PFI credits to high tonnage, the likelihood of increased interest from the market (better competition) and also the 'Joint Working' factor.

There are some strong grounds for joint working based upon economies of scale, the potential for PFI credits and increased market interest.

7.4 The Case for Joint Working

Should the authorities of Buckinghamshire and Milton Keynes work together?

This study has followed a measured approach and whilst several factors will ultimately determine the answer, this study considers three key criteria:

- Performance
- Financial
- Risk

Performance – there is not a strong case that joint working will hinder or enhance either authorities and should therefore be discounted.

Financial – the soft costs of acquiring a residual waste contract for either authority can be reduced through joint working. However, these should be discounted, as the hard costs of a long-term contract are significantly greater. The economies of scale demonstrate a benefit from joint working from a VFM perspective. The from of procurement, i.e. securing PFI credits will be enhanced by joint working.

Risk – the risks associated with technology choice, financability and the delivery of a given solution are manageable and are not specifically increased or decreased through joint working. If the authorities work together or independently they will face the risk of choosing an unproven technology, the risk of an unproven technology being financed and licensed and the risk of planning be permitted.

There are some straightforward reasons for working together predominantly economies of scale and that joint working attracts certain kudos from central government; however, a fundamental issue remains to be solved.

Local Authority waste management provision is based upon strategy and policy. In order for two parties to enjoy a successful working relationship, there is a need for similar objectives and preferably a synergy of approach.

In this instance BCC and MKC share the same objectives, both authorities agree to recycling and composting targets and have to adhere to LATS compliance.

At the present time both authorities have different core policy with regard to the treatment of residual MSW. The key difference being the presence of thermal treatment in the technology mix.

Currently MKC's waste strategy forbids the thermal treatment of MSW within the boundaries of the authority.

Using the best available information and current understanding the modelling exercises conducted by Jacobs Babtie have concluded that without the use of thermal treatment neither authority will be able to meet (let alone exceed) their respective LATS targets.

Before any further consideration for joint working, the issue of thermal policy must be addressed. Considering Milton Keynes as an independent authority there are three distinct routes to manage MSW for the next 25 years.

1. Change of policy would accommodate the potential for thermal treatment.
2. Court the risk of 3rd party RDF management. This report has examined the risks associated with 3rd party RDF management, and at present time there are few means that can be taken to reduce the associated risks.
3. Adopt a technology arrangement that relies upon landfill void space, which would be required at a yet to be determined premium.

In principle the benefits of joint working for BCC and MKC are:

- Increased likelihood of securing PFI credits due to joint working and increased tonnage.
- Economies of scale – VFM

- Market interest / competition

If the possibility of policy change for MKC is to be discounted either due to political will or the time associated with such reform then the opportunity and benefit for joint working will be very much reduced.

7.5 Way Forward

All three thermal treatments attract a degree of risk, however, Advanced Thermal Treatment is relatively unproven on treating MSW in the UK, and therefore may prove difficult to finance. Energy from Waste plants and Mechanical and Biological treatment coupled with a Fluidised Bed Gasifier are established technologies in Europe and the UK. These two technologies are recommended (either centralised or modular) if both authorities wish to take advantage of the economies of scale associated with joint working.