

MUNICIPAL WASTE MANAGEMENT STRATEGY FOR TORBAY **2008 - 2025**



Supplementary Report E: Appraisal of Municipal Solid Waste Options for Torbay February 2008

Municipal Waste Management Strategy for Torbay 2008 – 2025

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GLOSSARY

AC	Autoclaving
AD	Anaerobic Digestion
APC	Air Pollution Control residues
ATT	Advanced Thermal Treatment
BMT	Biological Mechanical Treatment
BMW	Biodegradable Municipal Waste
BVPI	Best Value Performance Indicator
CHP	Combined Heat and Power
CLO	Compost Like Output
EfW	Energy from Waste
EfW-CHP	Energy from Waste with Combined Heat and Power utilisation
IBA	Incinerator Bottom Ash
IVC	In-Vessel Composting
LATS	Landfill Allowances and Trading Scheme
HWRC	Household Waste Recycling Centre
MBT-AD	Mechanical Biological Treatment with Anaerobic Digestion
MBT-IVC	Mechanical Biological Treatment with In-Vessel Composting
MBT-SRF	Mechanical Biological Treatment producing an SRF
MRF	Materials Recycling Facility
MSW	Municipal Solid Waste
NPV	Net Present Value
RDF	Refuse Derived Fuel
ROCs	Renewables Obligation Certificates
RPS	RPS Planning & Development
SRF	Solid Recovered Fuel (an RDF produced to a technical specification)
tpa	Tonnes per annum

STRUCTURE OF THE MUNICIPAL WASTE MANAGEMENT STRATEGY

The Municipal Waste Management Strategy identifies how Torbay should manage its waste and has been produced in line with the guidance provided by Defra¹. The Strategy comprises of a number of documents which are summarised below in Figure 1.

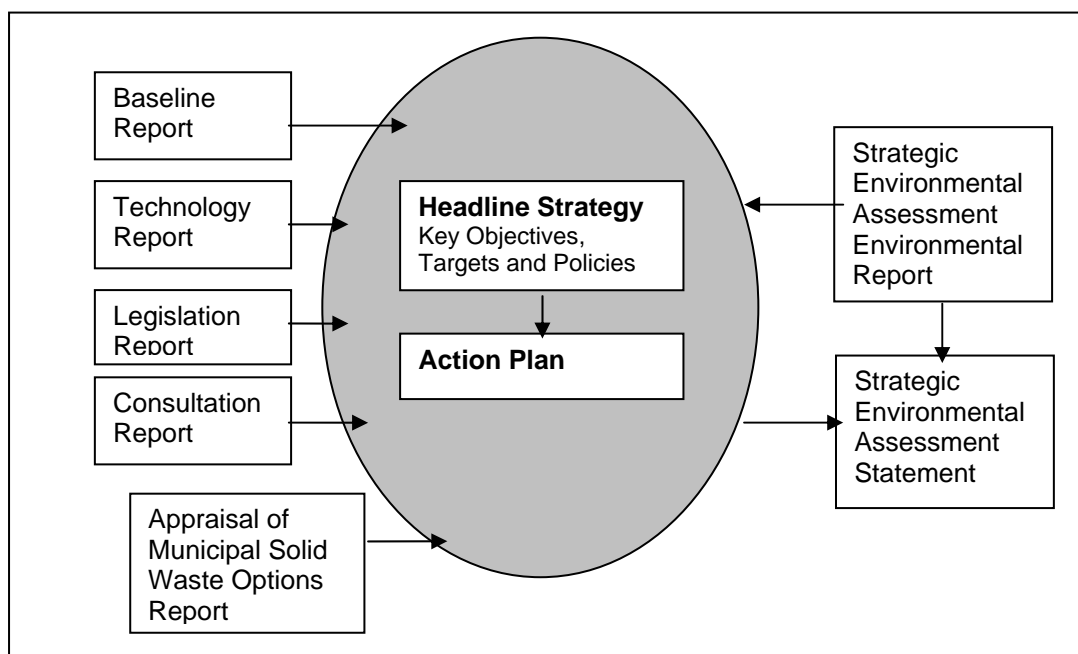


Figure 1: The Structure of the Municipal Waste Management Strategy

The Municipal Waste Management Strategy consists of the following documents:

- The **Headline Strategy**
 - o *What's the problem, what are we going to do?*
- The **Baseline Report**
 - o *Where are we now?*
- The **Technology Report**
 - o *Explanation of possible technologies*
- The **Legislation Report**
 - o *Legislation for change*
- The **Consultation Report**
 - o *How have stakeholders and the community been involved?*
- The Appraisal of Municipal Solid Waste Options for Torbay**
 - o ***Detailed analysis of options***
- The **Strategic Environmental Assessment (SEA) Environmental Report**
 - o *Likely environmental effects of the Strategy*
- The **Strategic Environmental Assessment (SEA) Statement**
 - o *How the findings of the SEA have been taken into account in the final Strategy*

This document contains the reports highlighted in bold above.

¹ A practice guide for the development of Municipal Waste Management Strategies, Defra 2005
www.defra.gov.uk

1 INTRODUCTION

Background

- 1.1 Torbay Council appointed RPS to develop specific options for the future management of Torbay's Municipal Solid Waste (MSW) and to appraise the preferred options on the basis of their environmental, social and economic sustainability. This options appraisal report forms part of the second consultation draft of Torbay's Waste Strategy.

Scope and Approach

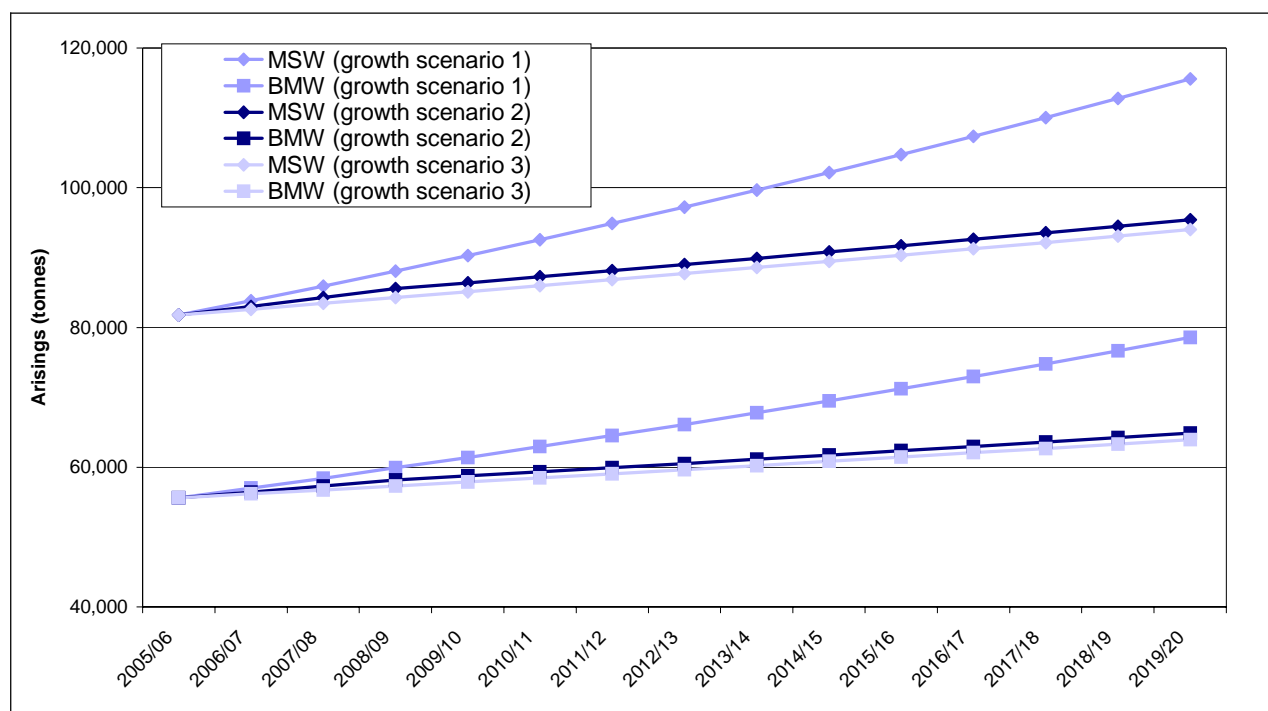
- 1.2 The following phased approach was used to assess the options available to Torbay in the management of its MSW:
- 1) Review of Landfill Allowances Trading Scheme (LATS) liabilities within the context of Torbay Council's targets and recycling performance;
 - 2) Review of residual waste treatment options which have the potential to meet Torbay's LATS targets and the development of a short-list of options for appraisal;
 - 3) Development of options appraisal criteria and associated weightings through an internal stakeholder workshop;
 - 4) Detailed options appraisal to identify, if appropriate, a preferred option or options for waste management in Torbay.
- 1.3 This technical report discusses the options appraisal and its outcome. Section 2 discusses Torbay's estimated waste growth, recycling performance and its estimated LATS liabilities. Section 3 discusses the residual waste management options which were reviewed as part of this study and presents the options short-listed for detailed appraisal. Section 4 summarises the options appraisal criteria and associated weightings which were developed at a workshop in June 2007, and presents the options appraisal results. Overall conclusions are presented in Section 5.

2 WASTE GROWTH, RECYCLING PERFORMANCE AND LATS LIABILITIES

Waste Growth Scenarios

- 2.1 To assess Torbay's likely requirements in terms of waste management infrastructure, it is necessary to consider in detail a range of factors. These include the estimated change in quantity of waste generated by Torbay up to 2020, and other associated factors such as the quantity of material that will be diverted from landfill by activities such as recycling and composting.
- 2.2 In order to undertake this analysis, three different waste growth scenarios have been defined for Torbay. These were agreed in discussion with Torbay Council:
- **Waste Growth Scenario 1** - 2.5% waste growth up 2019/20. This has been derived by taking Torbay's forecast population growth rate of 1% and combining it with a waste growth rate per head of 1.5% resulting in an overall waste growth of 2.5% per year. This is considered to represent a reasonable worst case.
 - **Waste Growth Scenario 2:** waste growth of 1.5% up to 2009/10 declining to 1% between 2009/10 and 2019/20. This scenario is considered to reflect a moderate waste growth scenario where waste growth is reduced in the medium term by waste minimisation initiatives.
 - **Waste Growth Scenario 3:** 1% growth up to 2019/20. This assumes that waste growth per head will not increase and that MSW as a whole will only increase in line with population growth. This could be considered to represent a 'best case' scenario.
- 2.3 Figure 2 illustrates each of these different waste growth scenarios and also shows the proportion of BMW generated. The figure illustrates the long term variation in estimates of waste arisings. For instance, Scenario 1 is estimated to generate approximately 20,000 tonnes more MSW than Scenario 3 by 2020.

Figure 2: Summary of MSW and BMW arisings for Waste Growth Scenarios



Recycling Options

2.4 Torbay Council has identified three different recycling options. These are described in detail in the Waste Strategy document. In summary:

- Recycling Option 1 (RO1) – Continue with current system:** Basic improvements to Torbay's existing recycling provision. Based on existing trends, it is assumed that recycling performance will increase by 0.5% per year under this option.
- Recycling Option 2 (RO2) – Build on current system:** Improvement of the infrastructure at civic amenity site and waste transfer station facilities to allow greater levels of recovery, and extension of existing kerbside recycling provision. It is assumed that recycling performance under this option will match Torbay's current household waste recycling target of 30% (note, however, this will not achieve the targets set in the recent Waste Strategy for England 2007²).
- Recycling Option 3 (RO3) – Build on current system plus kerbside collection of kitchen and garden waste:** Improvements under Recycling Option 2 (as above) plus the provision of a kerbside kitchen and garden waste collection for householders. This option also assumes that an in-vessel composting (IVC) facility will be developed for the treatment of these source-separated biodegradable wastes. Recycling performance under this option is assumed to be the same as for RO2 plus the additional level of performance achieved by a kitchen and garden waste collection.

2.5 The recycling performance for each option in the years up to 2020 are summarised in Figure 3.

Figure 3: Summary of Recycling and Composting Performance

Year	Recycling and Composting Performance (% of Household Waste)			
	RO1	RO2	RO3 ³	⊕RO3 revised estimate 2008 ⁴
2006/07	26.1	26.1	26.1	26
2007/08	26.1	26.1	26.1	27
2008/09	26.1	26.1	26.1	29
2009/10	26.6	30.0	38.5	37
2010/11	27.1	33.0	41.3	41
2011/12	27.6	33.0	41.1	44
2012/13	28.1	33.0	40.9	46
2013/14	28.6	33.0	40.7	47
2014/15	29.1	33.0	40.5	48
2015/16	29.6	40.0	47.3	48
2016/17	30.1	40.0	47.2	50
2017/18	30.6	40.0	47.0	50
2018/19	31.1	40.0	46.8	50
2019/20	31.6	40.0	46.7	50

⊕ Revised RO3 is derived from further analysis during 2008. It is included here for information only and is not used in the modelling within this report.

2.6 The figures illustrated in the table above relate to the recycling and composting of household waste. The Best Value Performance Indicator (BVPI) targets set for Torbay Council are for household waste. As discussed in the main strategy document, recycling and composting of household waste is achieved by three key activities: 1) kerbside collection of recyclable materials direct from households; 2) the collection and recycling of household waste via Torbay's civic amenity/recycling centre; and 3) material collected via recycling banks (e.g. 'bottle banks').

2.7 Household waste comprises the largest component of MSW. However, other components of MSW include street sweepings, park waste and waste collected from businesses. Some of

² The Waste Strategy for England 2007 (May 2007) sets out new household waste recycling targets for local authorities: 40% in 2010; 45% in 2015; and 50% in 2020.

³ For Recycling Option 3, the proportion of waste collected for recycling and composting declines slightly between 2010/11 and 2015/16 before increasing sharply in 2015/16. There is a similar trend between 2015/16 and 2019/20. This is because the quantity of waste collected via the kitchen and garden waste is assumed to stay constant whilst the total amount of waste is expected to grow. The values for Recycling Option 3 in Figure 3 are based on Waste Growth Scenario 1.

⁴ Revised February 2008 for Outline business Case modelling, joint sub-regional EfW (Entec UK©).

these non-household MSW materials are also recycled and composted. In assessing the options available to Torbay for managing waste materials it is necessary to consider the quantity of MSW as a whole and the level of recycling and composting of MSW which Torbay currently achieves and may achieve in the future.

2.8 The figures below illustrate the estimated recycling performance for total MSW. The figures present performance for each of the options and for each waste growth scenario, and also illustrate the level of residual waste generated (i.e. waste not recycled or composted).

Figure 4: Recycling Performance - Waste Growth Scenario 1 (2.5% Growth)

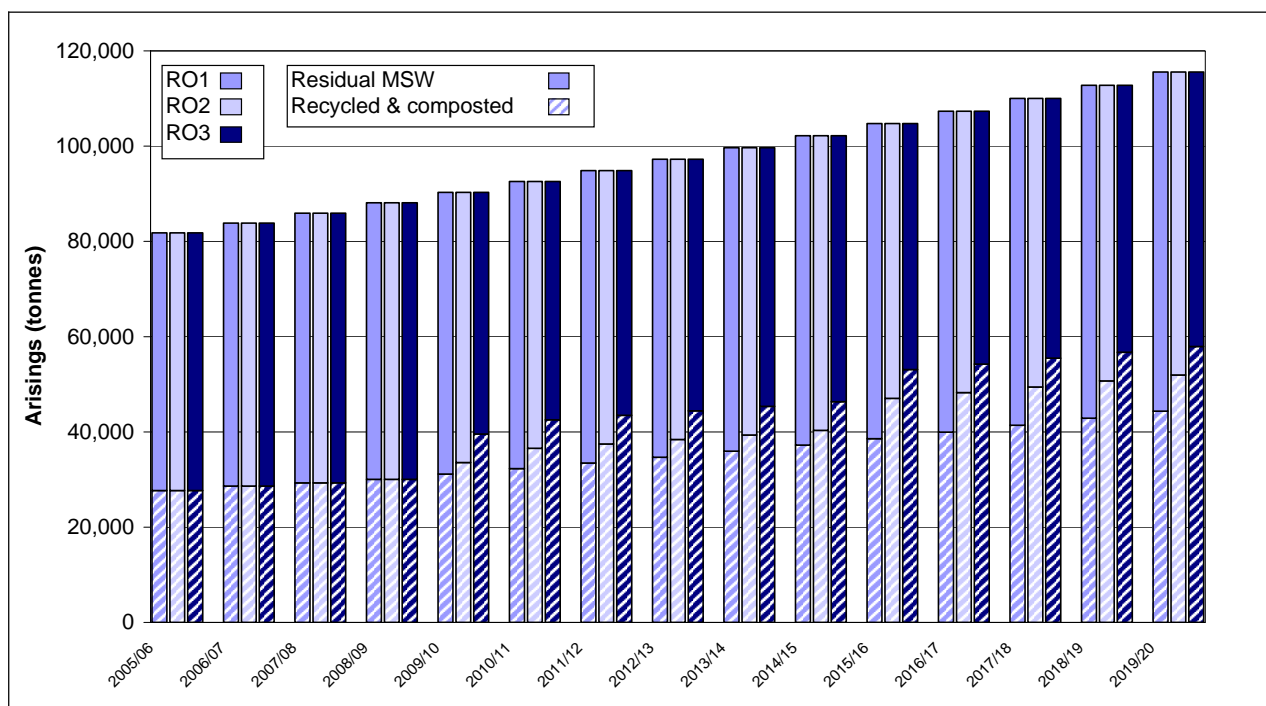


Figure 5: Recycling Performance - Waste Growth Scenario 2 (1.5% growth declining to 1%)

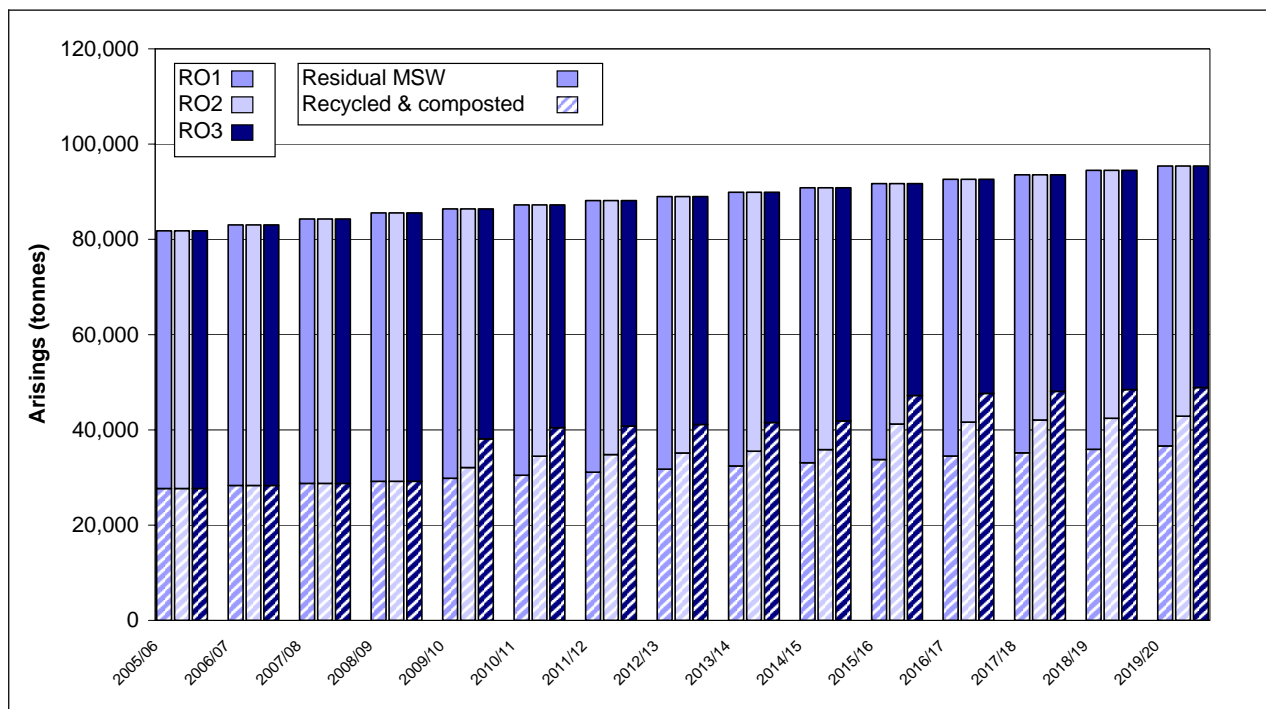
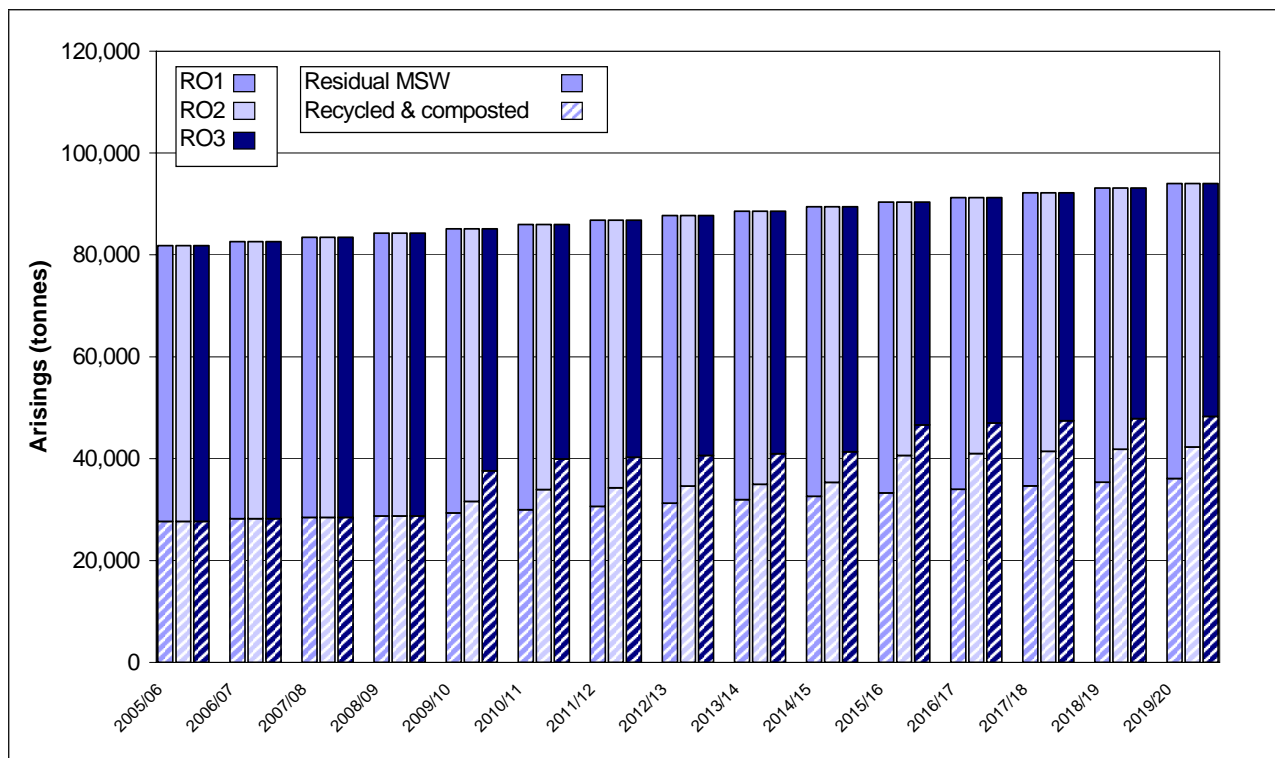


Figure 6: Recycling Performance - Waste Growth Scenario 3 (1% growth)

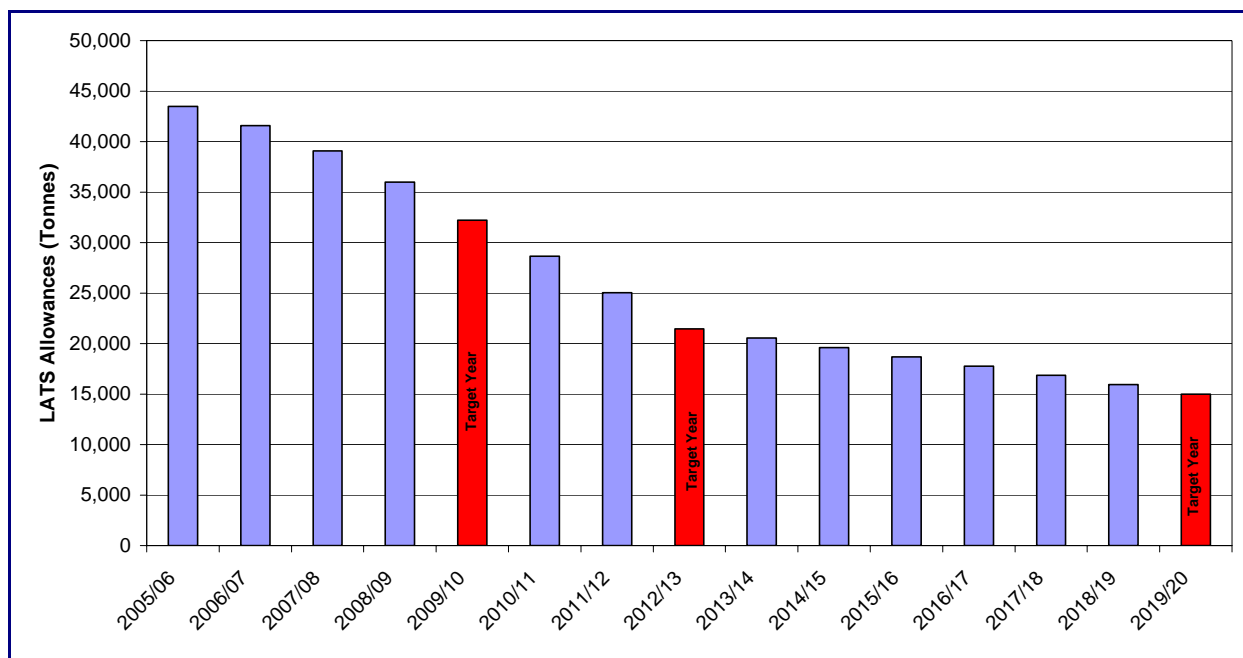


LATS Liabilities

- 2.9 The Waste Emissions and Trading Act sets the framework for the LATS. For each Waste Disposal Authority this regime sets annual targets for the quantity of biodegradable municipal waste (BMW) which an authority can landfill. These targets for individual local authorities reflect the national targets set in the Landfill Directive.
- 2.10 As the title of the regime implies, there is the potential to trade Landfill Allowances under the LATS scheme and also to bank and borrow them between different years. In summary:
- Where a local authority has a surplus of LATS Allowances compared to the quantity of biodegradable wastes landfilled, it can 'bank' an element of the allowances for use in later years. However, it is not possible to bank an allowance for use in or after a target year (i.e. 2009/10; 2012/13 and 2019/20)⁵.
 - A local authority can also 'borrow' an element of allowances from future years. Thus an Authority can defer the effect of a shortfall in LATS allowances by bringing forward the LATS allowances it has been allocated. As with banking, it is not possible to borrow into a target year or to borrow allowances from beyond a target year.
 - LATS allowances can also be 'traded' on the LATS allowance market. This allows local authorities to buy Allowances from other authorities that have a surplus.
 - Where a local authority exceeds its landfill allowances and is unable to acquire sufficient Landfill Allowances to account for the quantity of BMW landfilled, it must pay a fine of £150 per tonne.
- 2.11 Torbay Council's LATS targets are presented in Figure 7. The years highlighted in red are the target years.

⁵ The target years under the LATS scheme correspond to the dates of targets set at a national level in the Landfill Directive.

Figure 7: Summary of Torbay LATS Allowances



2.12 The figures below illustrate the LATS deficit faced by Torbay Council for each combination of waste growth scenario and recycling option. These projections are based upon detailed modelling of waste growth and the predicted diversion of materials from landfill through Torbay’s recycling and composting activities.

2.13 As can be seen in each figure, Torbay faces an increasing LATS shortfall from 2007/08 onwards. It is estimated that by 2019/20 Torbay will be generating between 16,000 and 37,000 tonnes more BMW than its LATS allowance for that year.

Figure 8: LATS Deficit - Waste Growth Scenario 1 (2.5% Growth)

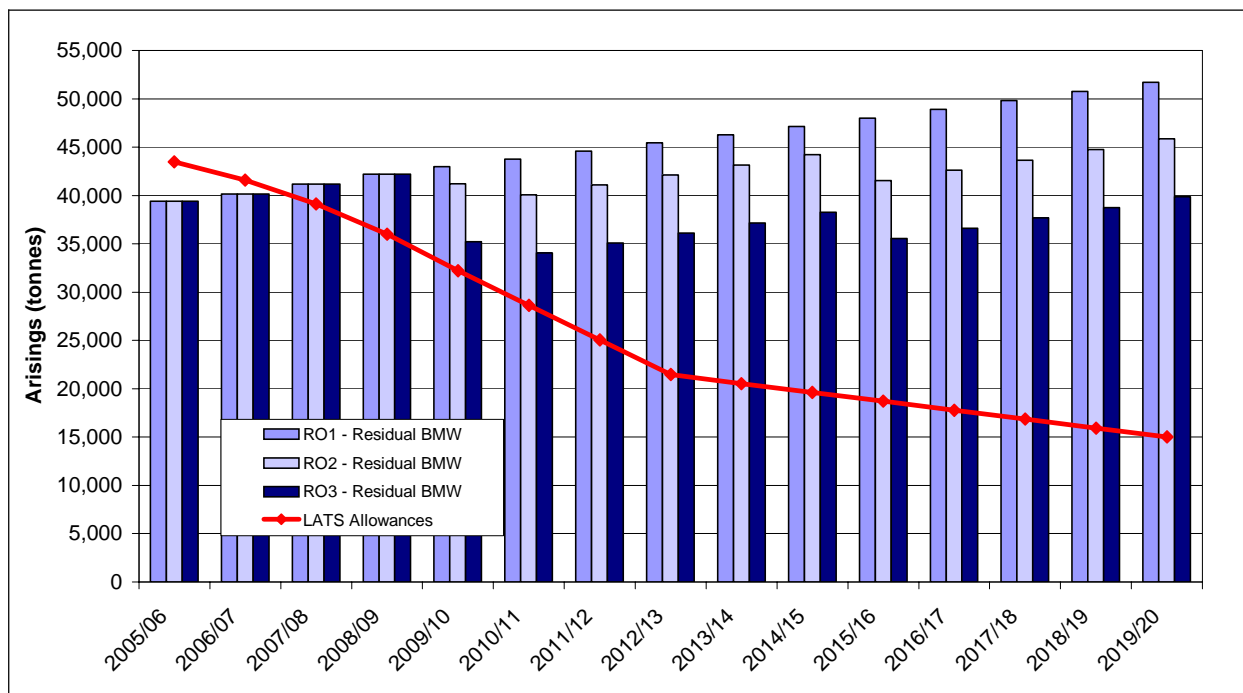


Figure 9: LATS Deficit - Waste Growth Scenario 2 (1.5% Growth declining to 1%)

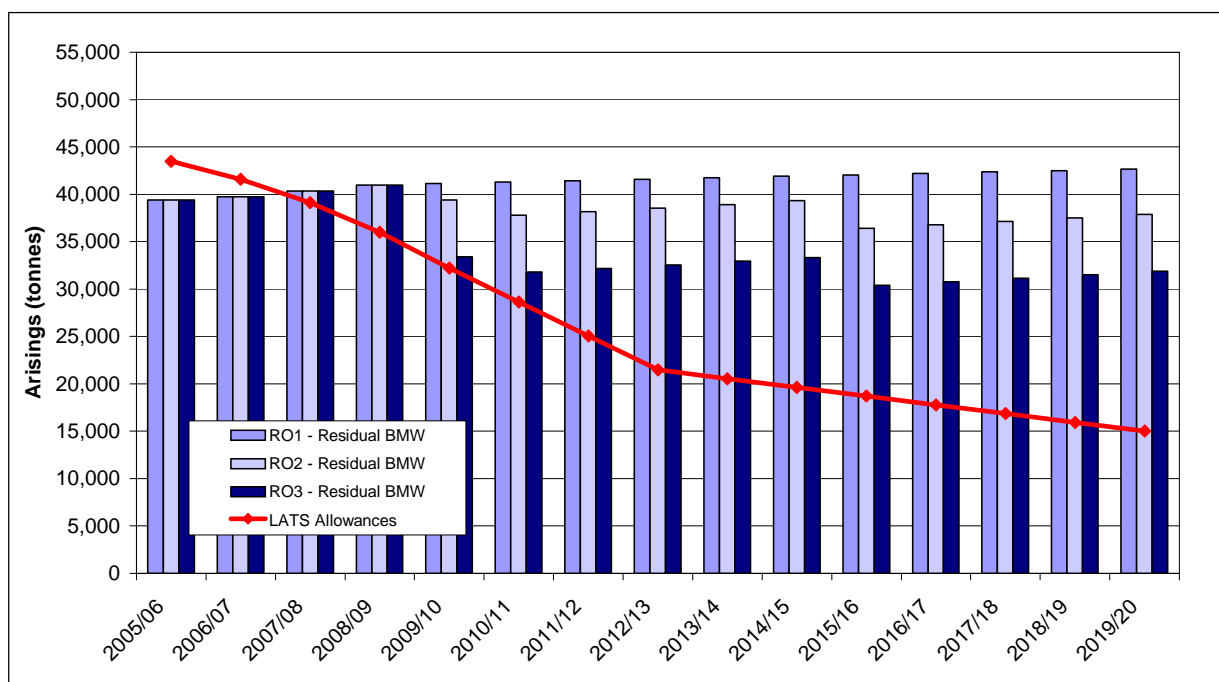
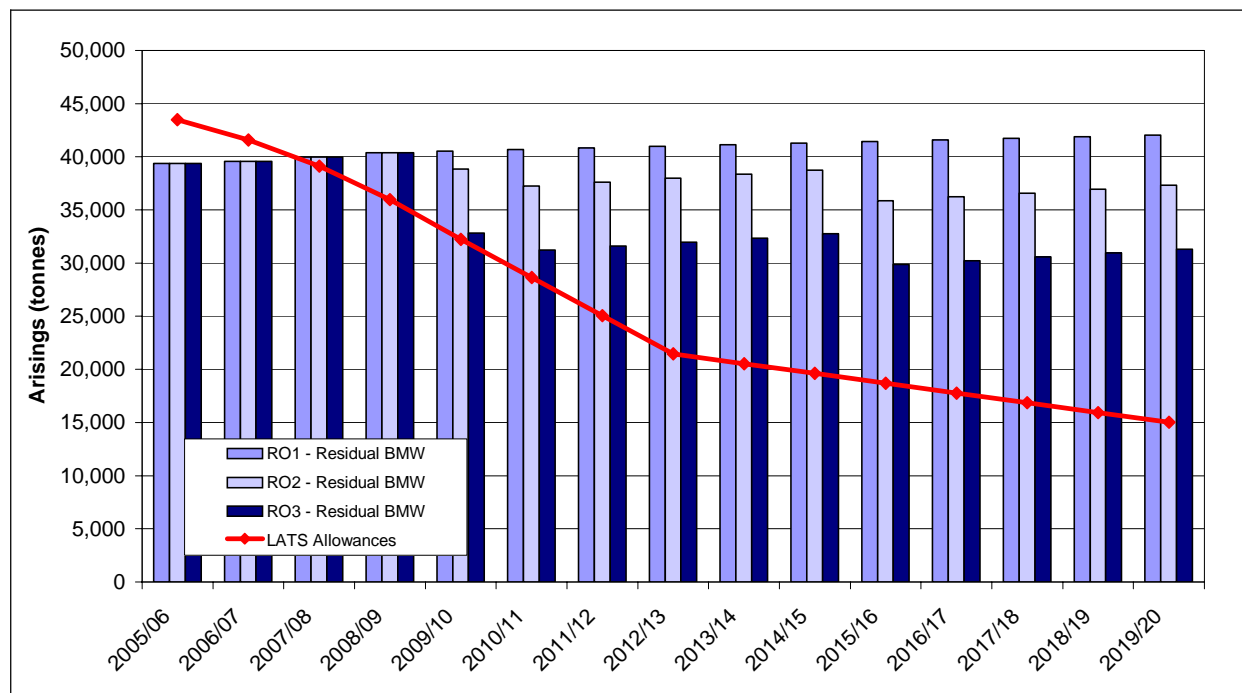


Figure 10: LATS Deficit - Waste Growth Scenario 3 (1% Growth)



2.14 The figures above illustrate the uncertainty that is inherent in estimating levels of waste growth over an extended time period. As discussed above, where the authority experiences a deficit of LATS Allowances relative to the quantity of BMW it landfills, the authority must bank or borrow where it can, or purchase LATS Allowances on the open market. If it fails to do this then it will face fines of £150 per tonne of deficit.

2.15 As shown in Figure 8, the estimated LATS deficit for a combination of waste growth scenario 1 (2.5% growth) and recycling option 1 (continue with current system) is a cumulative total of approximately 296,000 tonnes. It is possible to compensate for some of this deficit in 2007/08 and 2008/09 by banking up to 5% of the surplus Allowances from earlier years. This reduces the estimated deficit to approximately 290,000 tonnes. Note that there is no scope for banking or borrowing LATS Allowances after 2007/08. At a cost of £150 fine per tonne this deficit could equate to a total cumulative cost to Torbay Council of up to £44M.

2.16 By contrast, a combination of Waste Growth Scenario 3 and Recycling Option 3 result in an estimated cumulative LATS deficit of approximately 119,000 tonnes. Again, this deficit can be reduced by banking of the LATS surplus in earlier years resulting in an estimated deficit of 114,000 tonnes. At a cost of £150 fine per tonne this could equate to a total cumulative cost to Torbay Council of up to £17M.

- 2.17 The above assumes that Torbay Council will need to pay the LATS fines for any deficit. However, under the LATS scheme it is possible for the authority to buy LATS Allowances for less than the level of fines. Since the inception of the scheme in 2005/06, LATS Allowances have been traded on the market for between £20 and £30 per tonne. As LATS targets for local authorities reduce over the coming years, the availability of LATS Allowances is likely to decrease significantly and, as a result, the cost of an Allowance would be expected to increase. However, predicting the cost of future LATS Allowances is fraught with uncertainty and it is not possible to predict accurately the likely availability and future costs of LATS Allowances. As such, the figures discussed above represent reasonable worst case estimates of the potential cost to Torbay in the absence of any further landfill diversion for residual waste.

3 DEVELOPING A SHORT-LIST OF OPTIONS FOR APPRAISAL

Overall Approach

- 3.1 Whilst the shortfall in LATS and the resulting costs to Torbay Council could be significant, the procurement of residual waste management technology to divert BMW from landfill might enable the Council to meet its LATS targets in the medium to long term.
- 3.2 RPS worked closely with Torbay Council to review potential options for residual waste management and to develop a short-list of options for appraisal. The review process began with a long list of over sixty options capturing all potential combinations of recycling and composting activities, medium and long-term residual treatment solutions, partnership options and options with infrastructure both inside and outside Torbay. The long-list was based on the generic treatment options summarised in Figure 11. A summary of the technologies described in Figure 11 is provided in Annexe A.

Figure 11: Summary of Generic MSW Treatment Technology Options

Generic Technology	Specific Technology
Incineration	Energy from Waste (EfW) (Combustion)
Advanced Thermal Treatment (ATT)	Gasification
	Pyrolysis
Mechanical Biological Treatment (MBT)	MBT with In-Vessel Composting (MBT-IVC) producing a compost-like output (CLO)
	MBT with Anaerobic Digestion (MBT-AD)
	Autoclaving with Anaerobic Digestion (AC-AD)
Pre-treatment to produce Refuse Derived Fuel (RDF)	Autoclaving
	Biological Mechanical Treatment (BMT) or Biodrying

Source: RPS

- 3.3 In moving from the long-list to the short-list, each of the long-listed options was qualitatively assessed in terms of its suitability for Torbay. A number of issues were considered including:
- Issues and preferences identified at a stakeholder consultation workshop⁶ held in November 2006 and Torbay's Waste Strategy development.
 - Torbay's existing and proposed recycling and composting activities.

⁶ Stakeholder workshop undertaken by Torbay Council and Entec UK.

- The potential for Torbay to work in partnership with neighbouring local authorities, including possible opportunities for Torbay to transport MSW or treated waste materials (e.g. RDF) to existing or planned waste treatment facilities outside the Bay.

3.4 Each of these issues is discussed further below.

Recycling and Composting Activities

3.5 An outcome from the 2006 stakeholder consultation workshop was that the first priority is to improve existing recycling infrastructure and public education. All preferred options identified in the workshop involved building on the current recycling and composting collection system.

3.6 All options on the short-list reviewed assumed that front-end recovery would be maximised, i.e. all options are consistent with either Recycling Option 2⁷ or Recycling Option 3⁸ as described in the Torbay Waste Strategy, with the exception of the 'business as usual' option which will be assessed as recycling option 1.

Residual Waste Treatment Technologies

3.7 The November 2006 stakeholder consultation workshop identified the potential technology options as MBT, IVC, AC, EfW and ATT. The workshop report also identified some concern over the risk of using "new technology" whereas conversely some comments identified a wish for Torbay to be "at the forefront", i.e. adopting 'advanced' treatment technology. Due to this spectrum of comments the review of options for the appraisal short-list assumed that no technology options are ruled out and that Torbay is therefore currently 'technology neutral'.

3.8 ATT technologies under consideration are gasification and pyrolysis. Note that Figure 11 refers simply to ATT options for simplicity and because proprietary technology options may be configured to operate as either pyrolysis or gasification, or both in series.

3.9 A further key expectation from the stakeholder consultation workshop was that all preferred technology options should meet Torbay's specific characteristics, including MSW composition and the seasonality of MSW caused by tourism. As such, all options considered were reviewed on the basis of their ability to provide this flexibility. Note that the option to secure contracts for commercial or industrial waste provides this flexibility for all residual treatment technology options.

⁷ Recycling Option 2: Build on the current system. This involves a step change in Torbay's recycling practices to increase recycling and could involve, for example, additional civic amenity site and waste transfer facilities, improved Materials Recovery Facility (MRF) efficiency and kerbside collection of recyclables including garden waste.

⁸ Recycling Option 3: As recycling option 2 plus kerbside collection of kitchen waste and garden waste.

- 3.10 For the purposes of the options appraisal, the generic treatment options selected for the short-list were EfW, ATT and MBT. For the purposes of this report we have modelled a generic MBT process which could produce either a biologically stabilised material which could be landfilled or a RDF. Whilst AC was not specifically ruled out, it was not considered as a separate option because it is considered to be a form of waste treatment and, as such, could potential comprise a part of an MBT process. See Annex A for more information.

Availability of Sites for Treatment Infrastructure

- 3.11 It was assumed for the purposes of this report that at least one site would be available for developing new waste treatment infrastructure in Torbay. In identifying options for the appraisal, it was assumed that, due to Torbay's relatively small residual waste arisings, more than one site would not be required for residual waste treatment infrastructure.

Partnership Options

- 3.12 The stakeholder consultation identified that both partnership and self-sufficiency options should be evaluated. Additionally, a key expectation of stakeholders was to look beyond Torbay's boundaries in considering partnership options. Both partnership and self-sufficiency options were considered in the review of options. Note however that following consultation with Torbay, options were restricted to local authority partnerships. Furthermore, in undertaking the review of options it was assumed that any local authority partnership agreement would result in the export of residual MSW only and that Torbay would not enter a partnership resulting in net import of MSW.
- 3.13 In order to define the local authority partnership options available to Torbay and select options for the short-list, assumptions were made regarding existing or planned sites and technologies in the adjoining authorities that may offer treatment capacity for Torbay. These assumptions are summarised in Figure 12.

Figure 12: Availability of Waste Management Infrastructure Near Torbay

Technology	Existing Facilities*	New Facilities Planned*
Landfill	Heathfield (predicted to reached permitted capacity in 2016)	None
EfW	None	<ul style="list-style-type: none"> ▪ Plymouth (predicted from 2012/13): assumed capacity available. ▪ Exeter (from 2010): assumed no capacity available due to planning constraints and low capacity (approximately 60Ktpa).
ATT	None Note: use of Compact Power plant at Avonmouth, Bristol ruled out due to limited capacity and distance from Torbay	None
IVC	Heathfield IVC. Although there is not currently capacity at Heathfield, there may be potential to extend the facility at Heathfield to accept source-separated waste from Torbay.	None
AD	AnDigestion, Holsworthy (capacity available)☉	None
MBT	None Note: use of nearest existing MBT facility (New Earth Solutions at Canford, Poole) ruled out due to distance from Torbay.	None

Note:

This list was compiled in discussion with Torbay Council. A comprehensive review of facilities planned in the region was not undertaken and, as such, this list should not be seen as exhaustive.

☉Information included in February 2008.

Short-list of Options for Appraisal

3.14 The short-list derived from the process describe above is summarised in Figure 13. This short-list and the assumptions used in its development were reviewed and confirmed at a waste analysis workshop held on 4 June 2007. Further details of this workshop can be found in Annexe B.

Figure 13: Summary of Short-List

No.	Option	Description
1	Landfill	Landfill of all residual waste (business as usual) at Heathfield.
2	Regional EfW	Send residual waste to an EfW facility outside Torbay.
3	ATT	Develop an ATT facility in Torbay.
4	EfW	Develop an EfW facility in Torbay.
5	MBT-IVC-EfW	Develop an MBT-IVC facility in Torbay and send residues to an EfW outside Torbay.
6	MBT-AD-EfW	Develop an MBT-AD facility in Torbay and send residues to an EfW outside Torbay.
7	MBT-IVC-LF	Develop an MBT-IVC facility in Torbay and send residues to landfill outside Torbay.
8	MBT-AD-LF	Develop an MBT-AD facility in Torbay and send residues to landfill outside Torbay.

4 DETAILED OPTIONS APPRAISAL

Overall Approach

- 4.1 This section of the report outlines the approach taken by Torbay Council and RPS to assess and compare the costs, benefits and inherent risks of each option (see Section 3 for further details of the short-list of options). The methodology developed for this assessment is based upon the guidance published by the Office of Deputy Prime Minister (now Department for Communities and Local Government) in October 2002: "Strategic Planning for Sustainable Waste Management: Guidance on Option Development and Appraisal". The methodology comprises several stages.
- 4.2 Firstly, a set of assessment criteria was developed. Each of these assessment criteria was assigned a weighting to reflect its relative importance in the decision-making process. This criteria development and weighting process was undertaken at a workshop held on 4 June 2007. The workshop was attended by key internal stakeholders and decision-makers from Torbay Council and was facilitated by RPS. A summary of the resulting criteria, their definitions and associated weightings are presented in Figure 14. Further information on the waste analysis workshop can be found in Annexe B.
- 4.3 Secondly, each option was assessed against each criterion to derive a score. Where possible, a quantitative approach was used to score a criterion (e.g. an assessment of the number of jobs created by each option). Where it was not possible or appropriate to apply a quantitative approach for a specific criterion a qualitative approach was used. This involved assigning a score of between 1 and 5 for the criterion based upon a careful consideration of the associated issues (e.g. a qualitative assessment of the bankability of a particular waste treatment option). Figure 14 below summarises the scoring mechanism used for each criterion.
- 4.4 Thirdly, each score was then "normalised" to a scale of 0 to 1 to reflect its relative magnitude. This process allows scores of different criterion to be compared by converting them to a common scale. The lowest score for a particular criterion is normalised to 0 whilst the highest score is normalised to 1. All other scores are given a value between 0 and 1 in accordance with their relative values.
- 4.5 For example, the option generating the greatest number of jobs, say 10, would be given a score of 1. The option generating the least, say 2, would be given a score of 0. All other options are scored relatively between 0 and 1. So, for instance, an option generating 6 jobs would be given a score of 0.5.

- 4.6 Next, each score is assigned the weighting for that criterion. For example, the score of Jobs Created would be given a weighting of 1%. So, the option which generated 6 jobs (see above) would be assigned a normalised and weighted score for this criterion of 0.005 (i.e. $0.5 \times 1\%$).
- 4.7 Finally, once all scores have been normalised and weighted they are combined to give an overall score for each option.

Figure 14: Summary of Economic Assessment Criteria and Weightings

No	Criterion	Definition	Scoring Mechanism	Weighting
Economic Criteria (39%)				
1	Cost	<i>What is the overall lifetime cost of the project (in Net Present Value (NPV) terms)? This includes procurement costs and LATS trading/fines.</i>	<i>Quantitative assessment using NPV of each option.</i>	13%
2	Bankability	<i>Will the option attract funding from banks? This includes consideration of the viability of end-markets for outputs from the treatment process (e.g. recovered materials, electricity and heat).</i>	<i>Qualitative assessment^a. Those options which are more likely to attract funding score highest.</i>	9%
3	LATS compliance risk	<i>What level of diversion does the option achieve and what is the risk of the solution not achieving this level of LATS compliance?</i>	<i>Qualitative assessment^a. Those options which are predicted to achieve the lowest level of LATS liability and pose the lowest risk of achieving estimated diversion score highest.</i>	10%
4	Adequate market capacity / suppliers	<i>Does the waste technology market have sufficient capacity/suppliers to provide a competitive procurement process thus ensuring Torbay achieves a good economic solution?</i>	<i>Qualitative assessment^a. Those options for which there are the greatest number of potential suppliers score highest.</i>	7%

No	Criterion	Definition	Scoring Mechanism	Weighting
Technical Criteria (20%)				
1	Energy balance	<i>What level of energy recovery is the option likely to achieve?</i>	<i>Quantitative assessment using WRATE model outputs for Energy Recovered^b.</i>	4%
2	Technical reliability and robustness	<i>Is the technology proven in the UK or elsewhere?</i>	<i>Qualitative^a assessment. Those with a proven track record score highest.</i>	7%
3	Flexibility	<i>Can the technology cope with changes to waste quantity and composition? Does it have the flexibility to accept commercial and industrial waste streams in addition to MSW?</i>	<i>Qualitative assessment^a. Those options which have the flexibility to handle changes on waste composition and type score highest.</i>	5%
4	Future proofing	<i>Will the option stand up to future legislative/regulatory changes, and the likely cost impact for doing so?</i>	<i>Qualitative assessment^a. Those options which stand up to potential future changes to legislation (as far as we understand them at this stage) score highest.</i>	4%

No	Criterion	Definition	Scoring Mechanism	Weighting
Environmental and Social Criteria (25%)				
1	Greenhouse emissions gas	<i>What level of greenhouse gas emissions is the option likely to generate?</i>	<i>Quantitative assessment using WRATE model outputs for Global Warming Potential^p.</i>	4%
2	Local emissions	<i>What are the local emission levels from the technology, in terms of emissions to air, surface water and groundwater?</i>	<i>Quantitative assessment using WRATE model outputs for acidification, eutrophication, fresh water aquatic ecotoxicology and human toxicity^p.</i>	3%
3	Local amenity impacts	<i>What are the impacts of the solution in terms of dust, noise and odour?</i>	<i>Qualitative assessment^a. Those options which are typically associated with low levels of dust, noise and odour emissions score highest.</i>	3%
4	Visual impact (not site-dependent)	<i>What is the visual impact of the proposed solution? For instance, how tall is the required infrastructure? Could it be blended into its local environment? This impact is independent of the facility's location.</i>	<i>Qualitative assessment^a Those options which typically have a low visual impact in the local environment score highest.</i>	2%

No	Criterion	Definition	Scoring Mechanism	Weighting
5	Local landscape impact	<i>Would the solution impact on sensitive sites in Torbay?</i>	<i>Qualitative assessment^a. Those options which would be expected to have the lowest impact on the local Torbay landscape score highest.</i>	2%
6	Transport impacts and accessibility	<i>How far will waste materials need to be transported?</i>	<i>Quantitative assessment using results from transport model. Assessment considers only transport incurred from waste transfer station onwards. Includes transport associated with landfill of residues but not that associated with transport of recovered materials.</i>	2%
7	Jobs created	<i>How many jobs is the option likely to provide?</i>	<i>Quantitative estimate of number of jobs created for each option. Options which generate the most jobs score highest.</i>	1%
8	Residues to landfill	<i>Does the technology generate a significant quantity of residues (e.g. biostabilate or ash) requiring landfill disposal?</i>	<i>Quantitative estimate of quantity of materials or treatment residues which will require landfill. Options requiring greater levels of landfill score lowest.</i>	3%
9	Recycling BVPI	<i>Will the option contribute towards Torbay Council's Best Value targets for recycling?</i>	<i>Quantitative estimate of proportion of waste materials which will be</i>	2%

No	Criterion	Definition	Scoring Mechanism	Weighting
			<i>recovered and will also contribute towards BVPI target.</i>	
10	Energy Recovery BVPI	<i>Will the option contribute towards Torbay Council's Best Value targets for energy recovery?</i>	<i>Quantitative assessment of level of recovery which will contribute towards BVPI energy recovery target.</i>	2%
11	Site footprint requirements	<i>How much space will the infrastructure require?</i>	<i>Quantitative estimate of land space required for residual waste treatment infrastructure within Torbay. Those items with the least footprint score highest.</i>	1%
Planning Risk Criteria (16%)				
1	Public support and engagement	<i>Is the public likely to support the option?</i>	<i>Qualitative assessment^a. Those options which are likely to receive the highest relative levels of public support score highest.</i>	8%
2	Planning & development timescale	<i>What is the delivery timescale and what is the risk of delay?</i>	<i>Qualitative assessment^a. Options which are likely to take longest and entail the highest delivery risks score lowest.</i>	8%

Note:

a: All qualitative scoring mechanisms use a score of 1 to 5, where a score of 5 is most desirable.

b: For more information on the Environment Agency's WRATE model see: www.environment-agency.gov.uk.

Scoring of Quantitative Criteria

4.8 Extensive numerical modelling was undertaken to enable assessment of each of the quantitatively assessed criteria. Figure 14 indicates which criteria were evaluated with the use of numerical models. In summary, the following numerical models were used:

- **LATS Performance model.** The performance of different recycling and residual waste treatment options against Torbay's LATS targets up to 2020 was evaluated using RPS' in-house LATS model.
- **Environmental Life Cycle Assessment.** The Environment Agency's Life Cycle Assessment tool Waste and Resources Assessment Tool for the Environment (WRATE) was used to evaluate several of the environmental criteria. Box 1 provides some further information on the WRATE tool and life cycle assessment.
- **Transport model.** A bespoke transport model was developed to allow quantitative evaluation of the transport impacts associated with each option. The mileage over which waste materials and residues need to be transported was used as an indicator for the transport impacts associated with each option.
- **Financial model.** A financial model was developed to allow an indicative cash flow analysis of each option up to 2035, the typical duration of a long term waste management contract. This cash flow model was used to calculate the NPV for each option.
- **Residues to landfill model.** A bespoke model was developed to allow estimation of the quantity of MSW and/or residues that will require landfilling under each option.

Box 1 – Waste and Resources Assessment Tool for the Environment (WRATE)

The Environment Agency's Waste and Resources Assessment Tool for the Environment (WRATE) was used in this report to assess the green house gas emissions and local emissions associated with each short-listed waste management option. WRATE is a life cycle assessment tool and as such considers the impacts associated with the entire lifecycle of a product or service, from construction and operation, to its eventual decommissioning.

So for instance, a life cycle assessment of an EfW facility will consider the overall environmental burden associated with its construction (e.g. raw materials use), direct impacts caused by its operation (e.g. emissions to air, water and soil) and indirect impacts and benefits associated with its operation (e.g. the generation of energy which displaces the need to use other energy sources such as fossil fuels). In this way, a life cycle approach seeks to identify the relative performance of different options in terms of their overall cradle to grave impact.

The tool is an effective way of indicating differences between scenarios which are compared on a like-for-like basis. However, as with any assessment tool, life cycle assessment does have its limitations:

- Due to the way in which life cycle assessment tools consider impacts across the whole lifecycle, WRATE does not serve as a means for directly assessing the level of impact at a specific locality. Such an assessment is not possible at this stage of an options appraisal as it would be dependent upon a range of specific factors which have not been determined (e.g. site location, specific technology type, facility orientation, etc).
- The process does not typically differentiate between point emissions over a short period and diffuse emissions that occur over a long period. For example, no distinction is made between greenhouse gas emissions which occur in the short-term (e.g. those generated instantaneously by the combustion of waste in an EfW facility) compared with those which occur over a long time period (e.g. greenhouse gas emissions from landfilled waste which might occur over a period of, say, 100 years).
- WRATE also only allows the quantitative analysis of a limited number of environmental impacts. As identified in this report, there are a number of other environmental criteria which are important in considering waste management options for Torbay (e.g. transport impacts and local amenity impacts such as noise, odour and dust). These other criteria have been assessed using alternative methods.

Notwithstanding these limitations, WRATE is considered an appropriate means for assessing key environmental criteria and to assist in understanding the relative benefits and disbenefits of different options at this stage in Torbay's decision-making process.

- 4.9 A number of assumptions were made to allow each option to be defined in terms of its scope and nature and to enable the quantitative and qualitative modelling to be undertaken (e.g. commissioning dates, facility sizes, etc). The main assumptions are summarised in Figure 15. Each assumption was agreed with Torbay Council.
- 4.10 These assumptions are necessary to allow the comparative assessment of different options. Where possible they are based upon a balanced consideration of the most likely developments in the region and, where appropriate, match existing arrangements for the management of materials. For example, it is assumed that non-hazardous waste materials and residues generated by each option will be landfilled at Heathfield landfill site; and that the most likely location for an EfW outside Torbay that could take waste from the Bay would be in or near Plymouth.
- 4.11 It is important to note that a detailed viability assessment of each of the assumptions has not been undertaken and that these assumptions do not represent a commitment by Torbay or any other party to any particular option or course of action.

Figure 15: Key Assumptions for Reviewing Waste Treatment Options

Parameter	Assumptions
Sites	Where an option involves the development of residual waste treatment infrastructure, a single facility will be developed on one site. Due to the scale of waste arisings in Torbay, it is considered unlikely that more than one residual waste treatment facility would be required.
Existing & Planned Capacity	For options which comprise the development of infrastructure in Torbay, it is assumed that the facility will have a capacity of 65,000 tpa. This approximately equates to the estimated level of MSW arisings for Torbay in 2020 under Waste Growth Scenario 1 and Recycling Option 2. It is assumed that any surplus capacity will be used to treat commercial and industrial waste or MSW from outside of Torbay. The costs and benefits associated with the treatment of this additional waste have not been assessed.
	Where MSW, treated waste or residues are exported to facilities outside Torbay, it is assumed that sufficient capacity is available for treatment.
	Where required for residues generated by waste treatment processes, landfill capacity will be available at least up to 2020.
	For the 'Business as Usual' option, it is assumed that it will be possible to procure sufficient landfill space for MSW. For the purposes of modelling the impacts of this option it is assumed that this landfill space will be at the Heathfield site ⁹ .
	For the purposes of assessment and modelling, it is assumed that the Regional EfW Option comprises an EfW facility in or near Plymouth.
	Where an MBT outputs are exported for use in a EfW facility outside Torbay, it is assumed that capacity is available and that the facility is located in or near Plymouth.
Timescales	It is assumed that any option comprising an MBT facility will have treatment infrastructure commissioned in 2009/10. It is assumed that MSW will be landfilled at Heathfield landfill site prior to this commissioning date.
	It is assumed that any option comprising a thermal treatment facility (ATT or EfW) will have treatment infrastructure commissioned in 20012/13. It is assumed that MSW will be landfilled at Heathfield landfill site prior to this commissioning date.
	It is assumed that an EfW facility outside Torbay to which untreated MSW or MBT residues could be taken would be available from 2012/13.
Recycling & Composting	Torbay recycling option 2 or 3 will be applied to define front-end recovery.
	Torbay's Materials Recycling Facility (MRF) is currently not operational due to a fire. However, for the purposes of assessing different options it is assumed that this will not affect Torbay's long-term recycling performance.
	Compost from an IVC facility treating a feedstock of source-separated garden and kitchen waste will meet PAS100 standards and can be fully utilised thus delivering 100% BMW diversion from landfill.

Source: RPS

⁹ We understand that capacity at Heathfield landfill site is expected to be reached in 2016. However, as a new site has not been identified, we have used this as a basis for assessing options for this report.

Scoring of Qualitative Criteria

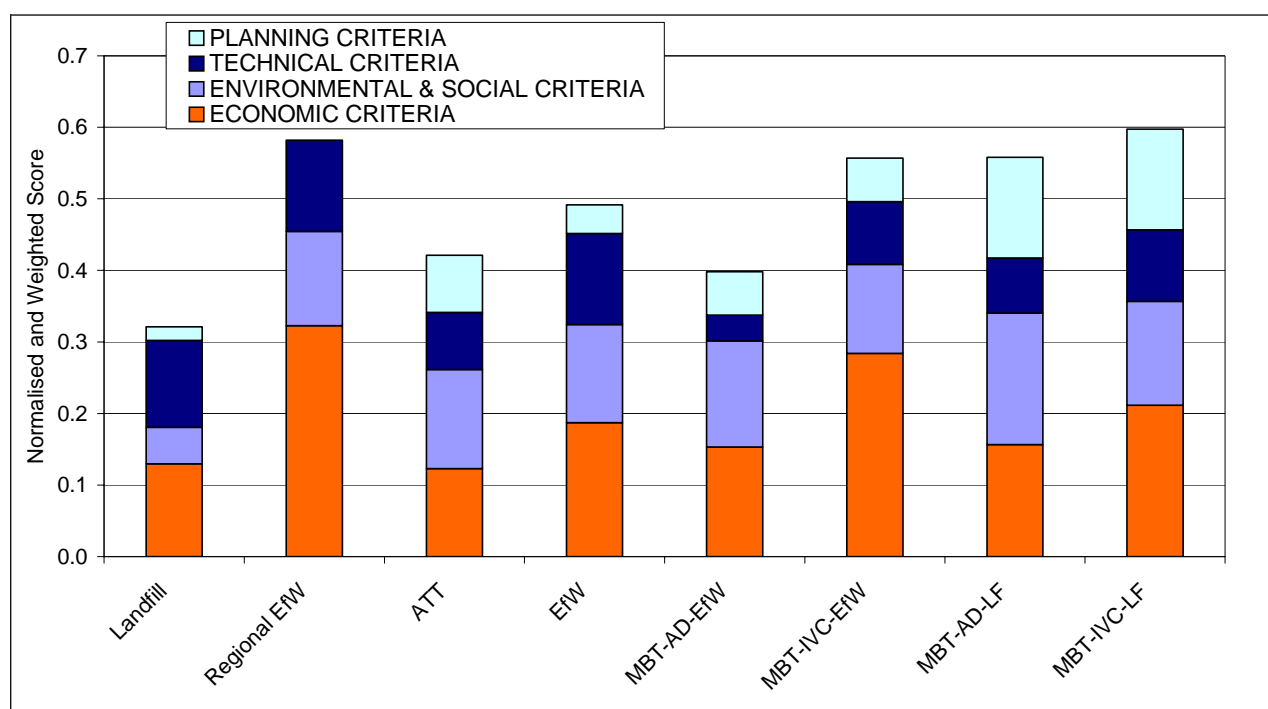
- 4.12 A number of criteria have been assessed using a qualitative mechanism. This approach assigns a score of between 1 and 5 to each option for that criterion. A score of 5 is the most desirable and a score of 1 is the least desirable.
- 4.13 This score is based upon a balanced assessment of the issues associated with that criterion by using information in the public domain and experience obtained by RPS and Torbay Council elsewhere.

Options Appraisal Results

- 4.14 Figure 16 illustrates the overall results of the options appraisal process. The numerical options appraisal output matrix can be found in Annexe C. Note that Recycling Option 2 has been used as the basis for the full options appraisal, with the exception of the 'business as usual' option which is based upon Recycling Option 1. The majority of assessment criterion are considered to be similar for Recycling Option 3. The relative costs of different residual treatment options with Recycling Options 2 and 3 has been considered in more detail and are discussed below.
- 4.15 MBT-IVC-LF option scores the highest but Regional EfW, MBT-IVC-EfW and MBT-AD-LF all perform well. Both MBT-LF options have high scores in all four types of criteria. Regional EfW and MBT-IVC-EfW options also score well, although they score poorly on the planning risk criteria. In summary:
- MBT-AD-LF and MBT-IVC-LF both perform well on all four types of criteria and scored the highest in terms of planning risk criteria. Although MBT-AD-LF does not score particularly well in terms of economic criteria, it is the strongest performer in terms of environmental and social criteria bringing its overall score up. MBT-IVC-LF scores particularly well on all criteria and is the option which has the overall highest score.
 - Regional EfW performs strongest in terms of economic performance. Although it scores the lowest in terms of planning risk, it also scores well in terms of technical and environmental and social criteria.
 - MBT-IVC-EfW scores well overall due to its particularly good economic performance; it scored second highest for economic criteria.
 - EfW scores moderately overall due to its average economic performance coupled with high scores for technical and environmental and social criteria. Its planning risk score was second lowest of all options.

- MBT-AD-EfW performed poorly due to its low economic score as well as a poor performance in terms of technical criteria. It scored moderately in terms of planning risk.
- ATT performed poorly in the options appraisal process due to its relatively poor economic performance. Scores for other criteria were moderate.
- Landfill was the lowest overall performer. Whilst its score for technical criteria was one of the highest, it performed very poorly against environmental and social criteria.

Figure 16: Summary of Options Appraisal Results



4.16 The process of evaluating and assessing criteria against which to judge waste technologies is a complex task with inherent limitations and should be considered with this in mind. Primarily, the weighting and ultimate scoring is in many cases a subjective exercise that deserves detailed consideration and discussion. It is important that the options appraisal process is not regarded as a method that generates a single answer. Instead the process should serve as a method for understanding the issues that contribute to one option being considered over another. A more detailed illustration and discussion of the options appraisal results is provided for each group of appraisal criteria below.

Economic Criteria

4.17 The Regional EfW option scores highest in terms of economic criteria. This is due to a combination of:

- Its low Net Present Cost (£52M). The regional EfW option and MBT-IVC-LF have the joint lowest estimated Net Present Cost (£52M).
- The relatively high level of bankability of EfW (i.e. it is a technology option that is likely to attract funding from banks). Note that landfill is considered to be the most bankable solution.
- EfW poses a low level of LATS liability.

4.18 A regional EfW option is considered to be moderate in terms of Adequacy of Market Capacity. Whilst EfW has a sufficient number of providers to ensure an economic procurement process, a regional facility would rely upon a neighbouring authority hosting a facility and is thus open to a higher level of risk in terms of availability for Torbay.

Cost

4.19 Due to its weighting of 13%, the highest of all criteria, the most dominant factor in appraising each option is Cost.

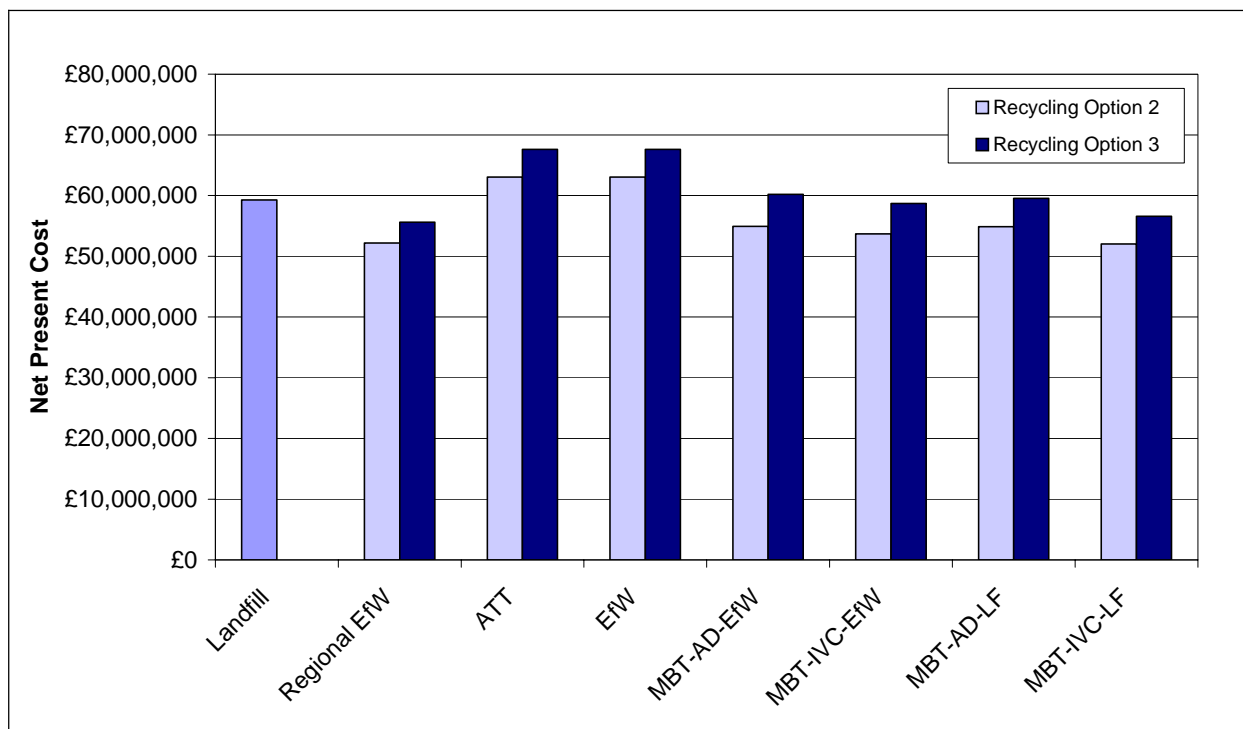
4.20 Figure 17 illustrates the relative Net Present Cost of each option. Note that the calculated Net Present Cost includes allowance for costs associated with new recycling infrastructure and transport of waste materials and residues, as well as the cost associated with residual waste treatment. These estimates of Net Present Cost are based upon a discount rate of 15%. Figure 18 illustrates the cost of each option in terms of a calculated cost per tonne (i.e. the rate per tonne which it would be necessary to levy to ensure a NPV of 0).

4.21 The use of NPV is an effective way of comparing options which have a different profile of capital and operational expenditure over time. For instance, some options involve high levels of capital expenditure in the short term with lower levels of operational costs over the long term, whilst others have lower or zero capital costs but higher long term operational costs. Discounting future costs to derive a NPV serves as a means for converting these costs to a single value for each option. The approach has been used as part of this options appraisal process to allow like-for-like comparison of options and is not intended as means for providing accurate figures for budgeting purposes. The NPV is based upon costs and revenues for each option up to 2035. This represents the typical duration of a long term waste management contract.

4.22 As can be seen, the Regional EfW and MBT-IVC-LF options have the lowest Net Present Cost. However, all the MBT solutions are within £3M of Regional EfW in terms of Net Present Cost. The two thermal solutions (ATT and EfW) are the most expensive in Net Present Cost terms (£63M). The business as usual Landfill option is also relatively costly at £59M.

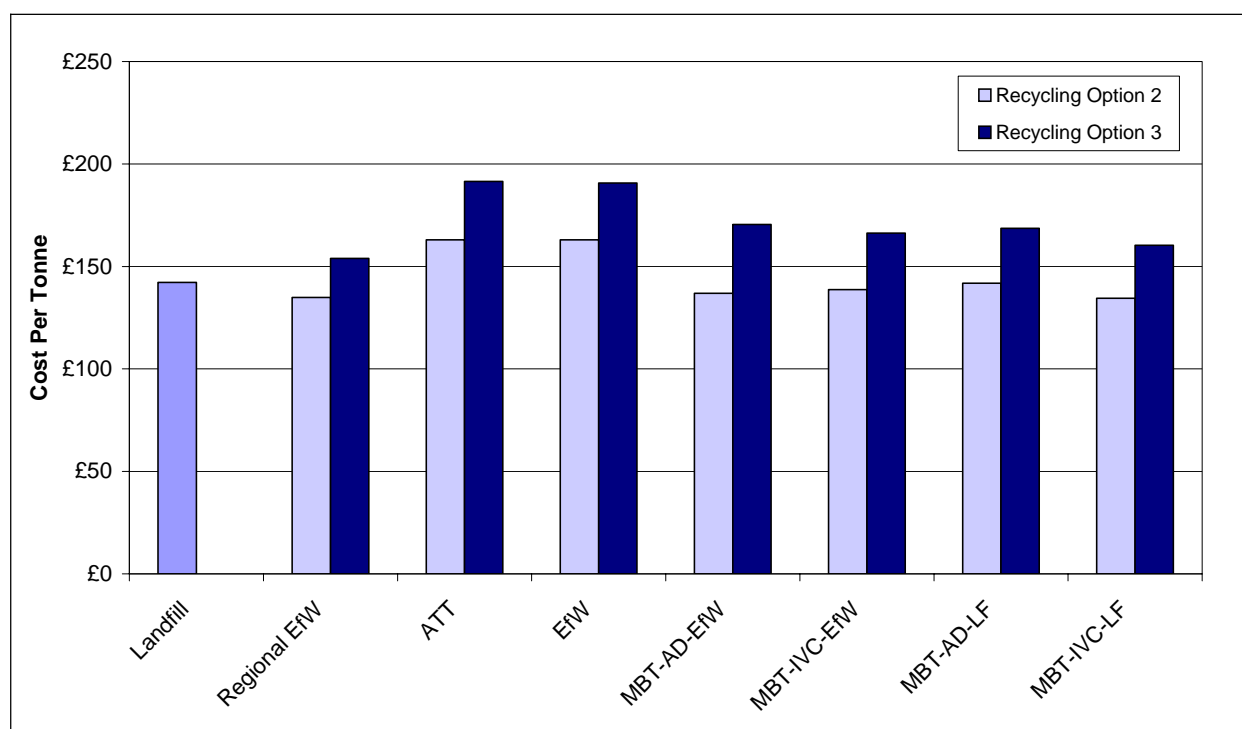
4.23 A more detailed discussion of the costs associated with each option together with a discussion of the key factors which influence the overall cost of each option is provided below.

Figure 17: Summary of Estimated Net Present Cost for Each Option



Note: Landfill option based on Recycling Option 1.

Figure 18: Summary of Calculated Cost per Tonne



Note: Landfill option based on Recycling Option 1.

Capital and Operational Costs

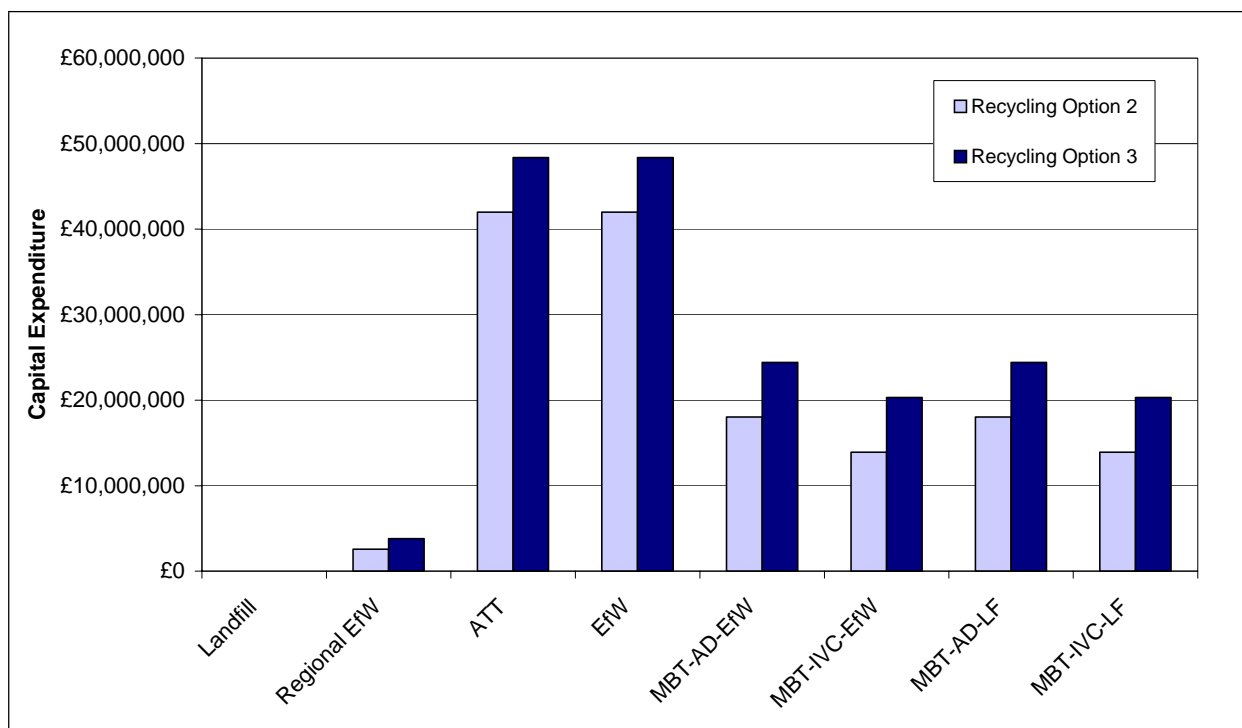
4.24 Figure 18 and 19 illustrate the estimated capital and operational costs for each option. Whilst the cost of purchasing any necessary LATS Allowances is a part of the operational cost for an option, due to the uncertainty of LATS Allowance values in the future, it is more appropriate to consider the LATS deficit separately for each option (see below). The figures illustrate the following issues:

- EfW and ATT are associated with particularly high capital costs. However, their operational costs are the lowest of all options (due to the high levels of revenue which these thermal solutions attract through the sale of power and possibly heat).
- The Regional EfW has the highest estimated operational cost. This is due to the gate fee which an EfW is likely to charge for accepting MSW and is also associated with high transport costs required to transport Torbay's MSW to an EfW outside the Bay. The capital costs for this option are those associated with developing infrastructure for Recycling Options 2 and 3.
- All the MBT-based options involve much lower capital costs than the ATT or EfW options. Of the MBT options, the generic MBT-IVC option is considered to have a

lower capital cost than the MBT-AD option because of the more technically complex infrastructure that is typically required for the latter.

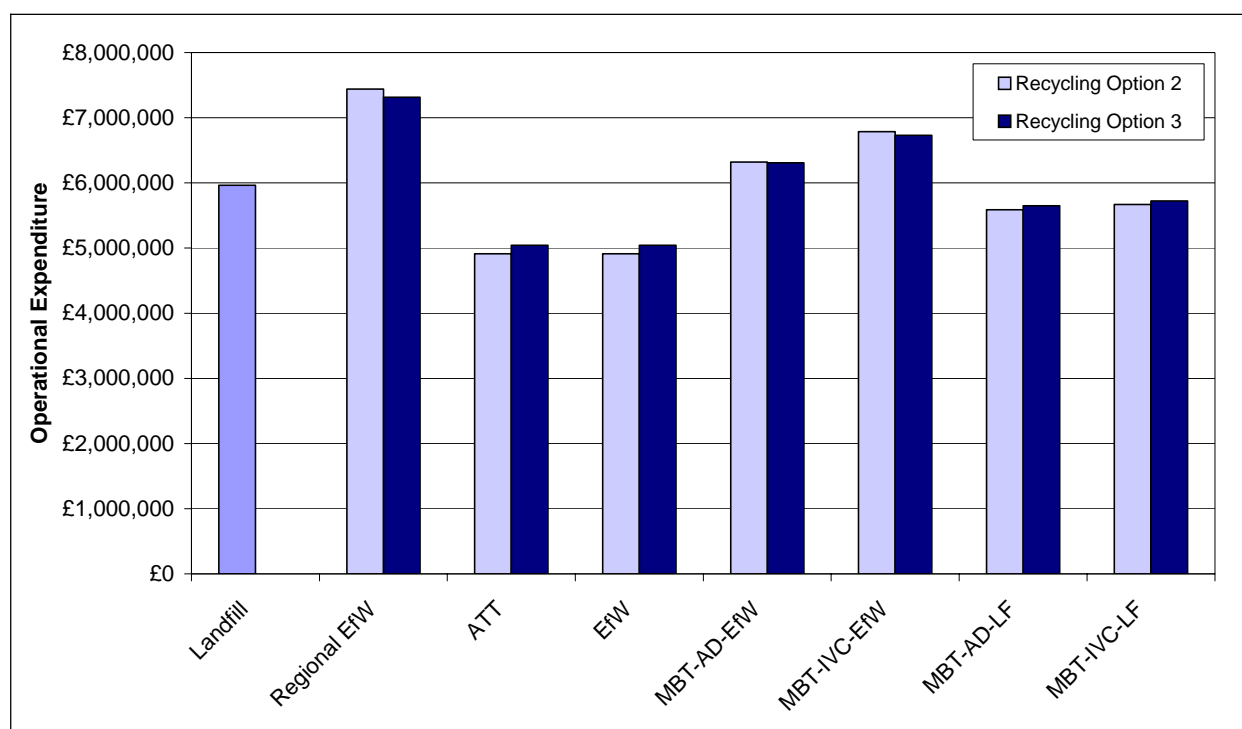
- The operational costs of all the MBT options are of a similar magnitude. Whilst, the operational costs of an MBT-IVC facility are considered to be lower than an MBT-AD facility, the greater revenues associated with the possible sale of heat and power from AD mean that, on balance, they are similar. It is also interesting to note that the operational costs for the MBT-LF options are lower than the MBT-EfW options. Whilst, the MBT-LF options incur significant landfill gate fee and tax costs, the combination of the likely gate fee charged for the RDF produced by the MBT process and the associated transport costs are estimated to be higher over the long term. This issue is discussed further below.
- The Landfill option is assumed to incur no capital costs and has a moderate operational cost in comparison with other options. It is important to note that the operational costs illustrated in Figure 19 do not include the costs of purchasing LATS allowances to cover the significant LATS deficit associated with the landfill option (see Figure 21). At a purchase cost of £120/t the cost associated with purchasing sufficient LATS allowances to cover the deficit is approximately £3M in 2012/13. This factor is reflected in the NPV of the landfill option.

Figure 19: Summary of Capital Costs



Note: Landfill option based on Recycling Option 1.

Figure 20: Summary of Operational cost costs in 2012/13 (first comparable year of operation)

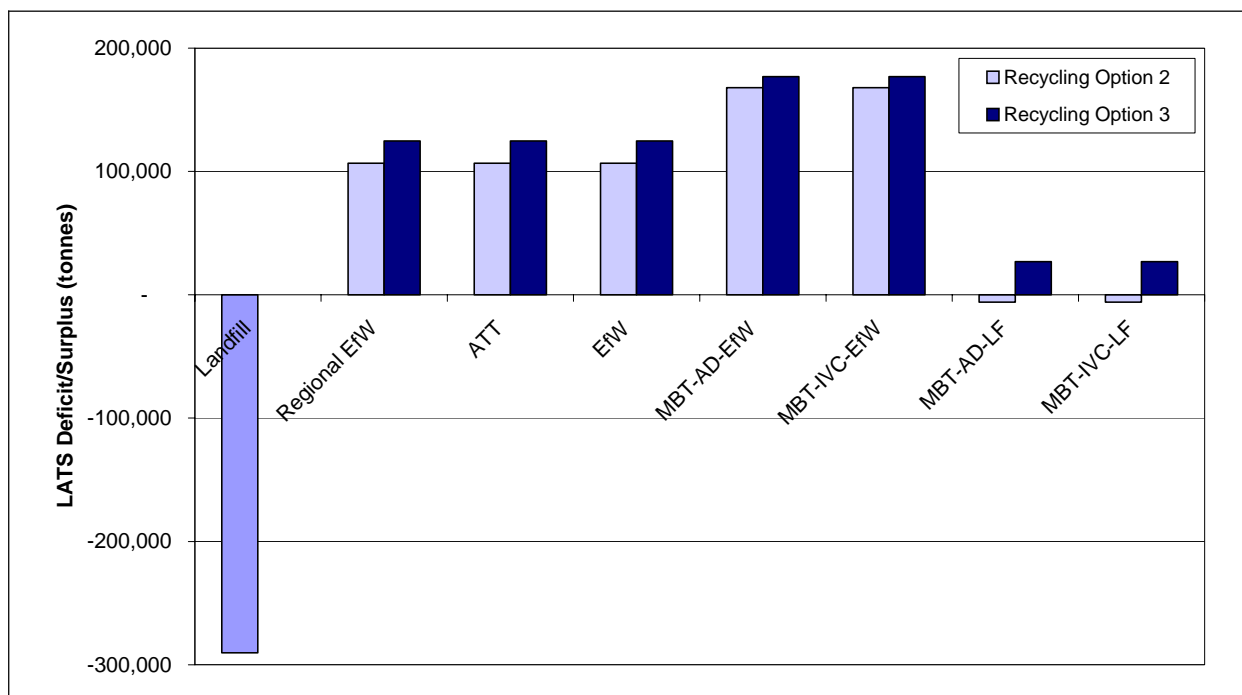


Note: Landfill option based on Recycling Option 1.

LATS Deficit/Surplus

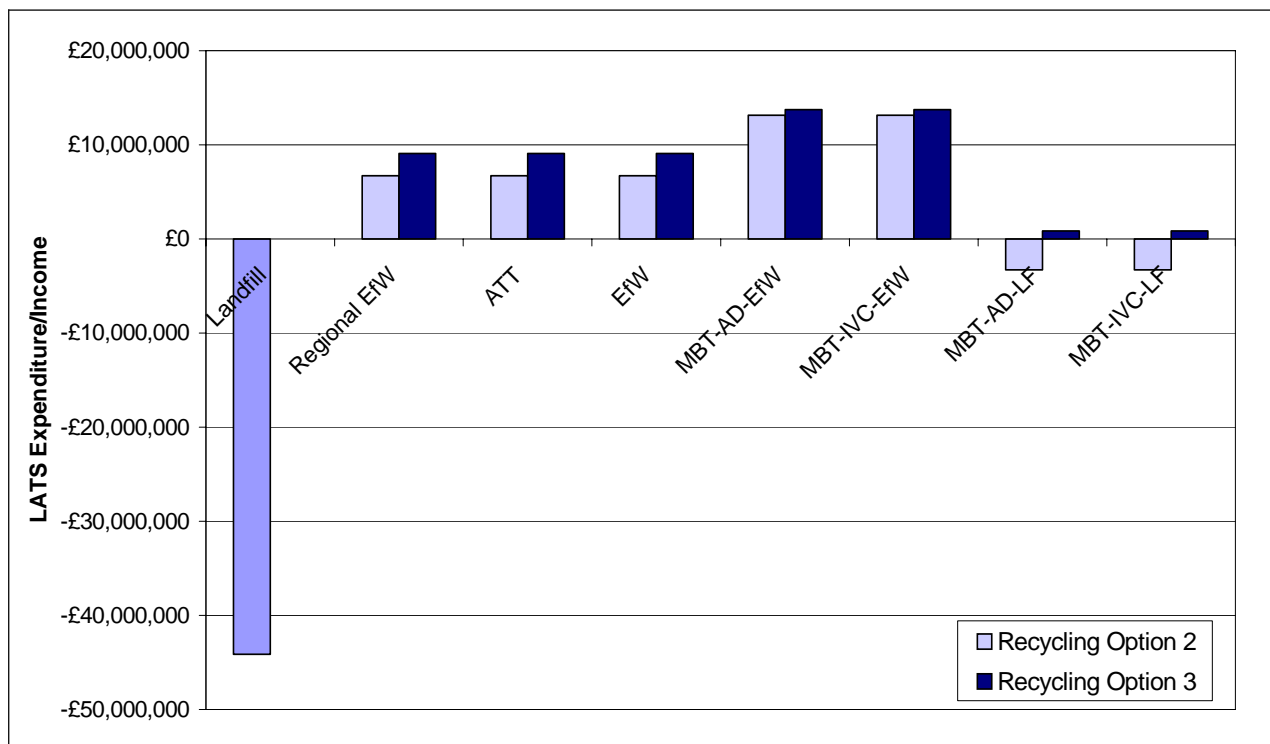
- 4.25 The charts below illustrate the estimated LATS deficit/surplus for each of the short-listed options. These estimates are based upon Waste Growth Scenario 1.
- 4.26 As illustrated in Figure 21, The MBT-IVC-EfW and MBT-AD-EfW options are estimated to pose the lowest levels of LATS liability. This is due to: firstly, the MBT process being commissioned earlier relative to EfW or ATT commissioning and hence diverting BMW from landfill from an earlier date; and secondly the thermal treatment of residues from the IVC and AD processes ensures a high level of BMW diversion in the long term.
- 4.27 Figure 22 illustrates the estimated LATS liability for each option. The business as usual scenario poses the greatest LATS liability. The MBT-IVC-LF and MBT-AD-LF options when combined with Recycling Option 2 are also estimated to result in a cumulative LATS deficit by 2020.
- 4.28 Figures 22 to 25 demonstrate the individual LATS profiles over time for each option. These charts illustrate whether an option is in LATS surplus or deficit each year up to 2020.

Figure 21: Cumulative LATS Surplus/Deficit (All Options)



Note: Landfill option based on Recycling Option 1.

Figure 22: Cumulative LATS Income/Expenditure (All Options)



Notes: Landfill option based on Recycling Option 1.
 Income values assume that excess LATS Allowances can be sold for £60 per tonne.
 Expenditure values assume that any short-fall in LATS Allowances will cost £120 per tonne.

Figure 23: LATS Surplus/Deficit Profile – Landfill

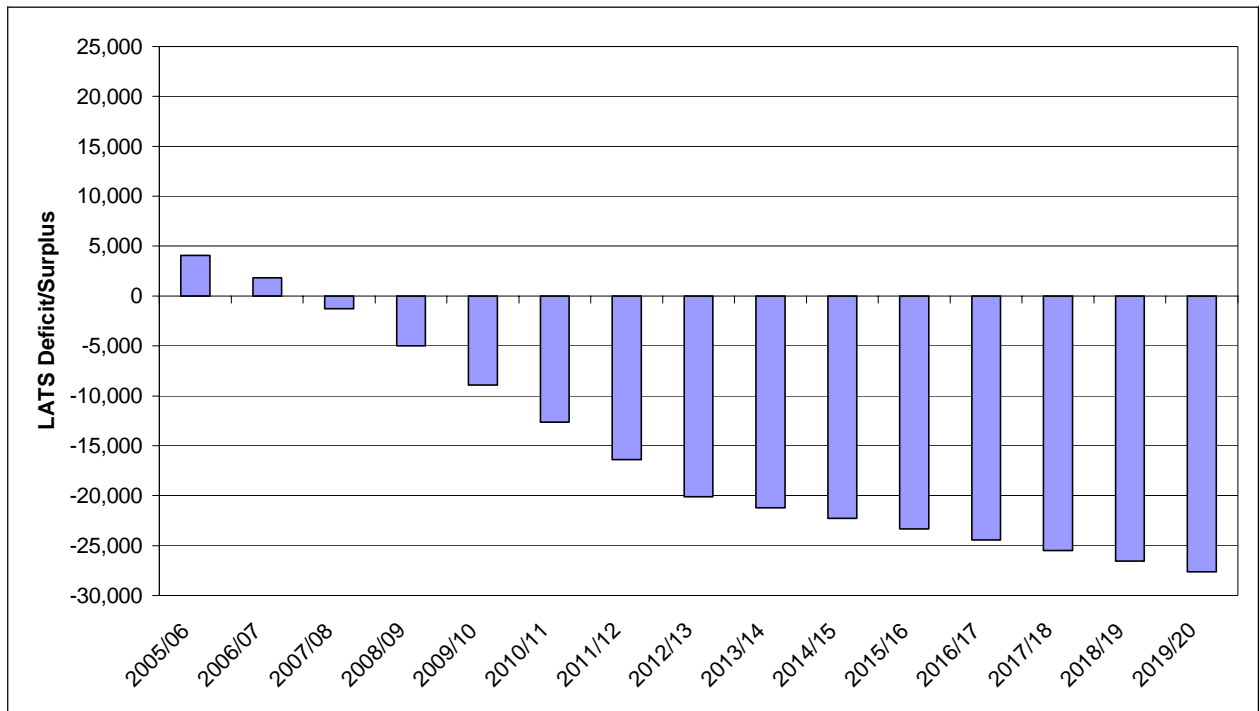


Figure 24: LATS Surplus/Deficit Profile – ATT and EfW

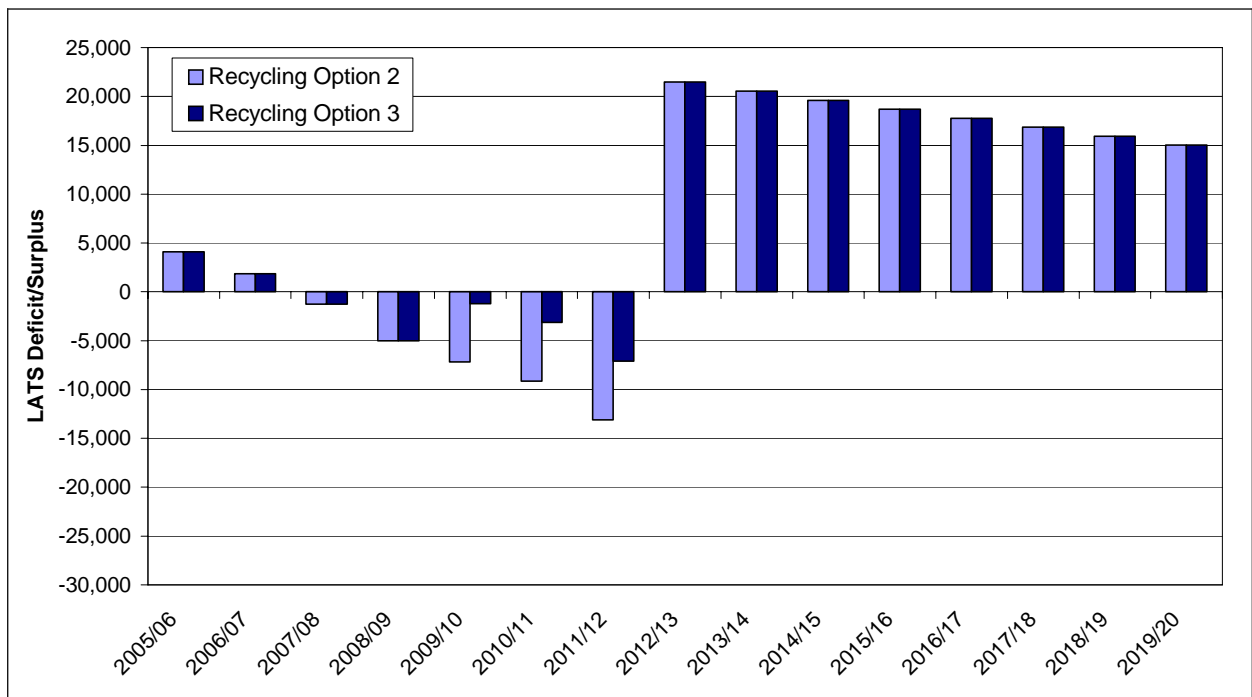


Figure 25: LATS Surplus/Deficit Profile – MBT-EfW Options

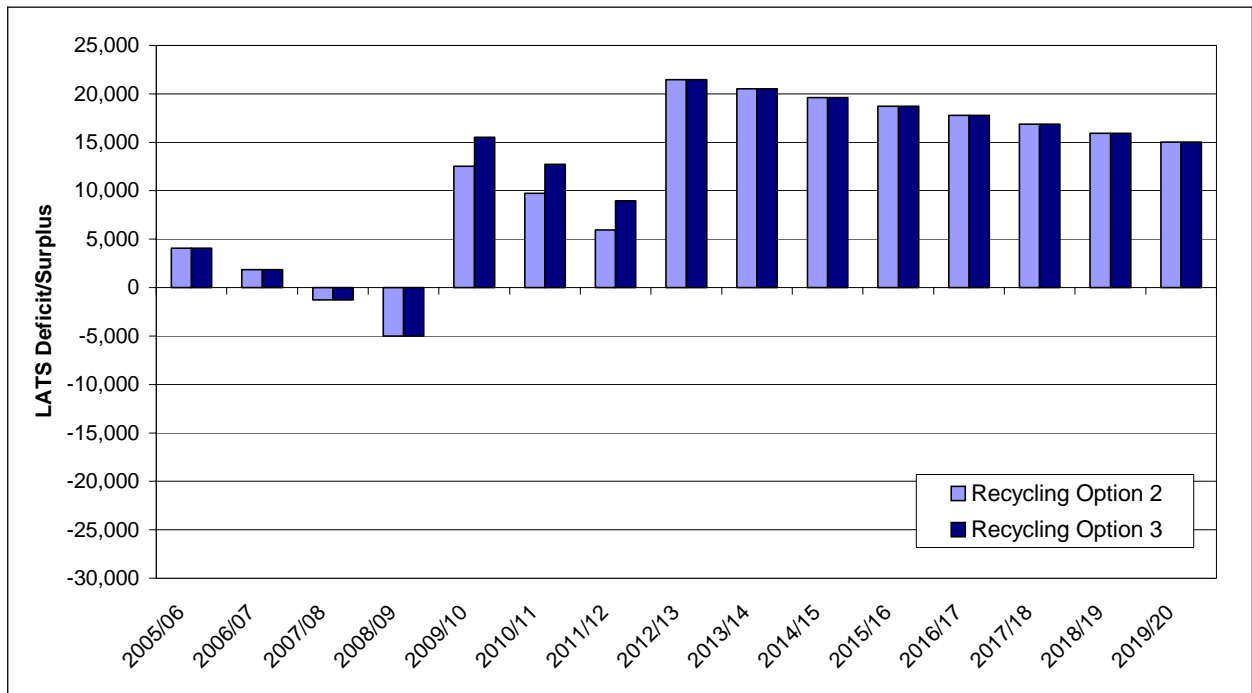
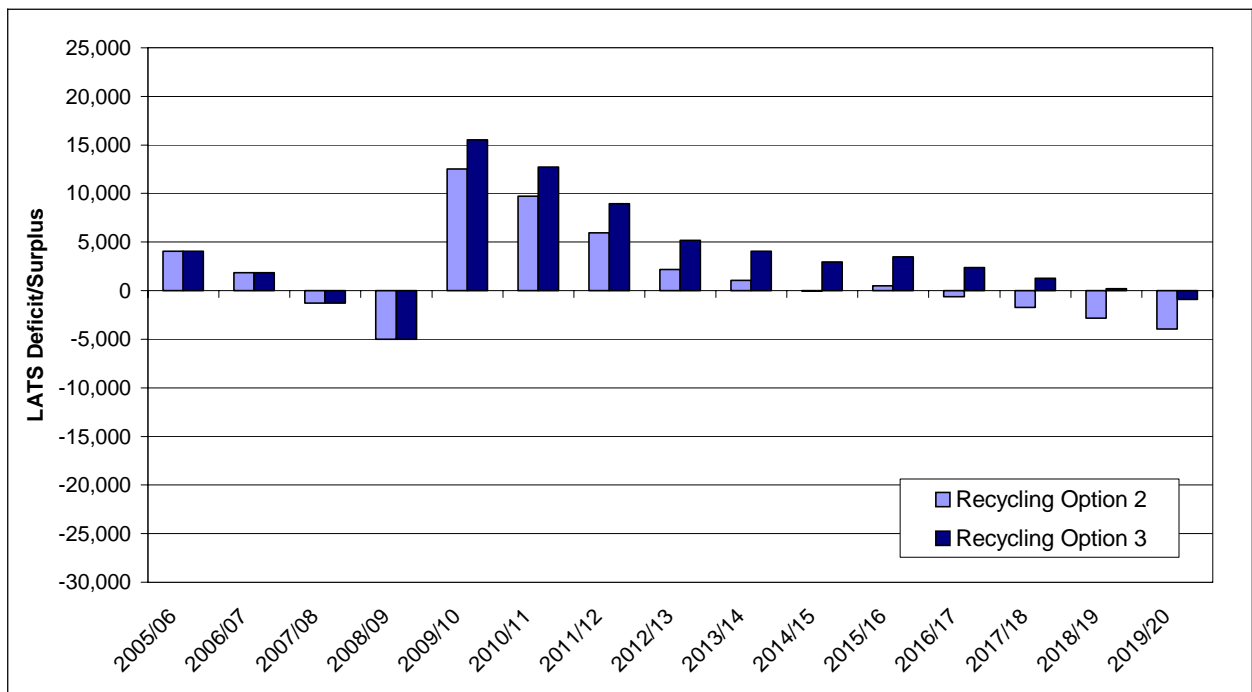


Figure 26: LATS Surplus/Deficit Profile – MBT-LF Options



LATS sale and purchase prices

4.29 The NPV values illustrated in Figure 17 assume a LATS allowance sale price of £60/t and a LATS allowance purchase price of £120/t. These values are considered to represent a fair reflection of potential longer term costs and revenues associated with LATS. As one would expect, these variables have a strong influence on the costs of different options. High LATS purchase and sale prices strongly favour those options which generate a LATS surplus. So for instance, all thermal options (EfW and ATT) which achieve the highest level of BMW diversion attract high revenue streams associated with the sale of LATS allowances. Conversely, low LATS allowance purchase or sale prices, favour those options with a lower LATS surplus or deficit (i.e. those options which involve the landfill of BMW such as MBT-LF options and the business as usual option. If the cost of a LATS allowance is reduced to £30 then Landfill is the cheapest option in NPV terms. Even so, reducing the LATS values does not alter the relative ranking of different options (other than landfill) and as discussed above, a LATS price of £30/t is not considered to be a realistic long term value.

Revenue Income

4.30 The operational costs of different options are strongly influenced by the level of revenue income that different residual treatment technologies attract. The thermal treatment options have the lowest operational costs due to the high revenues which they can secure through the sale of power and potentially heat. For instance, reducing the revenue associated with EfW options from £25/t to £15/t increases the operational cost of these options to the approximately same level as MBT options.

4.31 Similarly, options involving AD (i.e. MBT-AD-EfW and MBT-AD-LF) attract high levels of revenue income through the sale of heat and potentially power. By contrast, the options comprising MBT-IVC do not generate a revenue from power and heat (and are in fact a user of energy). Again, if the assumed revenue from AD options is reduced from £17/t to £10/t then their operational cost increases to the same as the equivalent MBT-IVC options and also increases their estimated Net Present Cost to greater than MBT-IVC options.

Gate fee for RDF

4.32 The MBT-AD-EfW and MBT-IVC-EfW options assume that the mechanical biological treatment process will be used to generate a RDF that will be sent at a cost to an EfW facility. The gate fee cost for this RDF is a significant variable in determining the operational cost for these options. Given the current uncertainty in the availability of outlets for RDF, a value of £75/t has been assumed for the cost estimates illustrated here. This contributes to the high operational cost of MBT-EfW options relative to MBT-LF options. Obviously, reducing the

assumed gate fee for RDF reduces the operational cost associated with these options. If the gate fee were reduced to £40/t then the operational cost for these options would be the same or lower than the equivalent MBT-LF options, and would also mean that MBT-IVC-EfW is the cheapest in terms of overall net present cost.

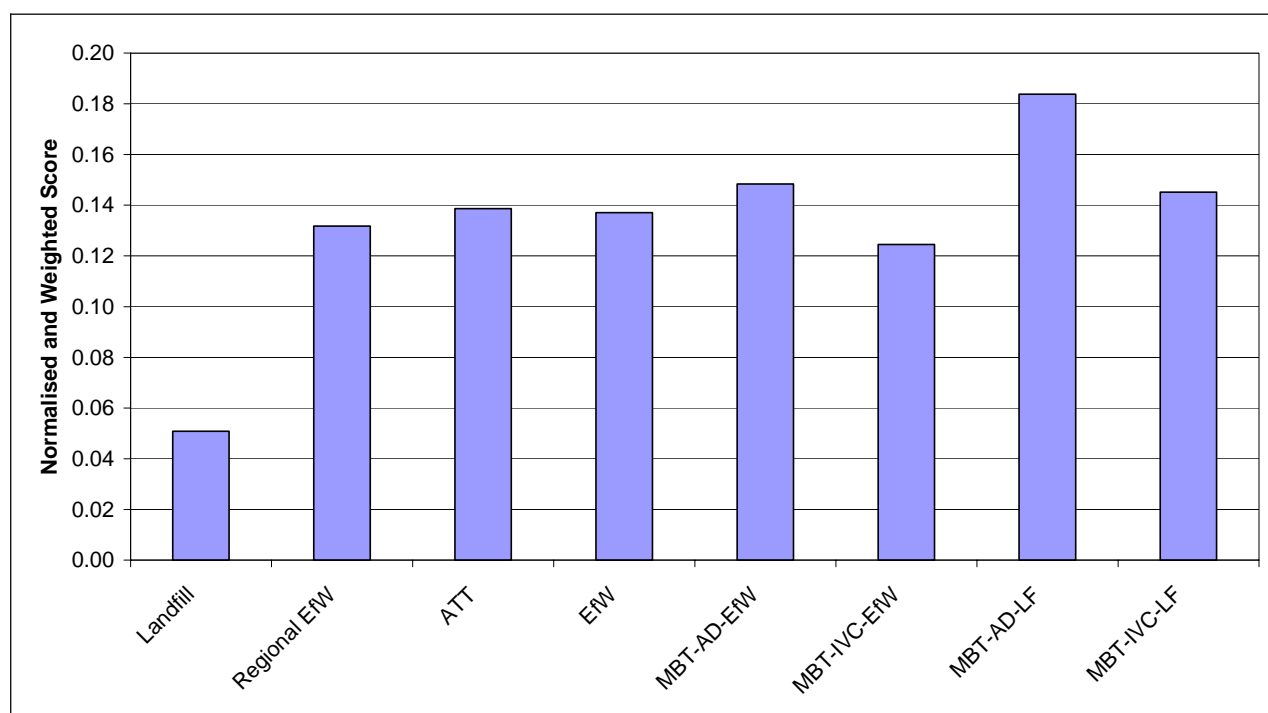
Comparison of RO2 and RO3

- 4.33 In NPV terms, Recycling Option 3 is more costly in comparison to Recycling Option 2 for all options. Recycling Option 3 is estimated to add approximately £6M in capital costs for each short-list option. This cost relates to capital expenditure for developing an IVC unit for treating source-separated kitchen and garden wastes, and for other associated vehicles and equipment which will be necessary to implement Recycling Option 3.
- 4.34 In terms of operational costs there is no consistent effect on each option. Some options are slightly more costly in terms of operational cost with Recycling Option 3 whilst others are slightly cheaper. For example, the operational cost of the Regional EfW option is lower for RO3 than RO2 because the former involves the transport of lower quantities of residual waste out of Torbay and results in a significant associated saving. A similar effect is seen with MBT-EfW options. Conversely, the operational cost is higher for RO3 when combined with ATT, EfW or MBT-LF options. This is because RO3 introduces additional transport costs associated with the movement of separately collected material to the IVC facility.
- 4.35 Overall, in NPV terms these savings do not compensate for the additional capital and operational expenditure associated with the kerbside collection operations and IVC operation. However, it is important to note that other issues need to be considered when deciding whether or not to introduce Recycling Option 3 (e.g. the driver to meet BVPI recycling targets and maximise diversion of BMW material from landfill).

Environmental and Social Criteria

- 4.36 Figure 26 illustrates the environmental and social scores for each option. The MBT-AD options score highest in terms of environmental and social impacts and benefits, with MBT-AD-LF being the strongest performer. With the exception of Landfill, all other options perform similarly.
- 4.37 The performance of different options against each of the environmental and social criteria is discussed below.

Figure 27: Summary of Environmental and Social Scores



Greenhouse Gas Emissions

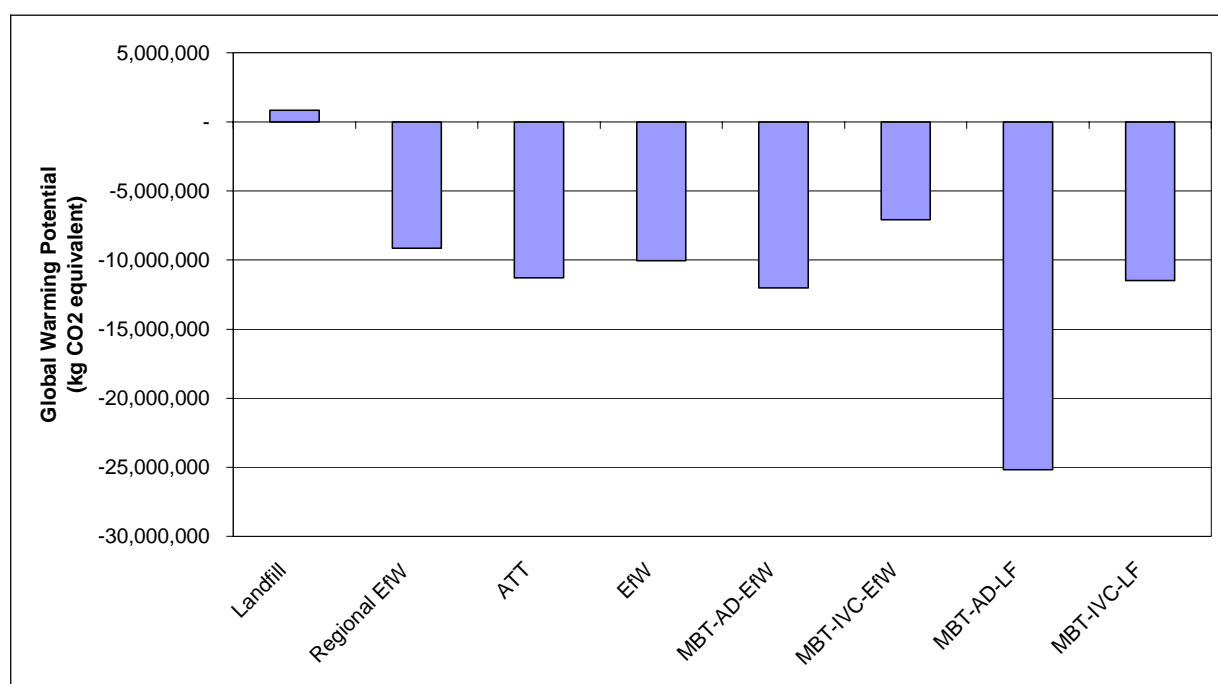
4.38 The Environment Agency’s WRATE tool was used to assess the Greenhouse Gas Emissions impact of each option. The WRATE tool uses a process developed by the International Panel on Climate Change to calculate the global warming effect over 100 years by considering the estimated level of emissions of different greenhouse gases. This impact is expressed in terms of carbon dioxide equivalents (i.e. the quantity of carbon dioxide which would be required to be emitted to have the same impact).

4.39 The results of the assessment are illustrated in Figure 28. With the exception of landfill, all options possess a negative Global Warming Potential (i.e. the energy and materials used and recovered by the processes generate an overall net benefit in terms of global warming potential). Note that all options have at least some component of energy recovery, including landfill. Landfill gas is extracted from modern landfills to generate energy. Overall, the combination of MBT-AD and landfilling of residues performs best in terms of Greenhouse Gas Emissions, generating the biggest single benefit in terms of displaced greenhouse gas emissions.

4.40 The net overall benefit in terms of global warming potential is primarily due to the estimated reductions in greenhouse gas emissions associated with the recycling of materials from both direct household waste recycling (Recycling Option 2) and materials recovery at the residual

treatment stage. If we consider residual treatment alone, then MBT-AD-LF is the only option where the global warming potential associated with the lifecycle of the waste treatment infrastructure itself results in an overall net benefit (i.e. the construction and operation of an MBT-AD facility results in an overall saving in greenhouse gas emissions if we take into account the savings associated with the energy generated by the facility. By contrast, the construction of all other types of facility considered result in an overall global warming impact, even if we take into account the energy generated by EfW or ATT facilities).

Figure 28: Green House Gas Emissions



Local Emissions

4.41 The performance of each option in terms of local emissions for each option are illustrated in Figure 29. These figures relate to the WRATE indicators for:

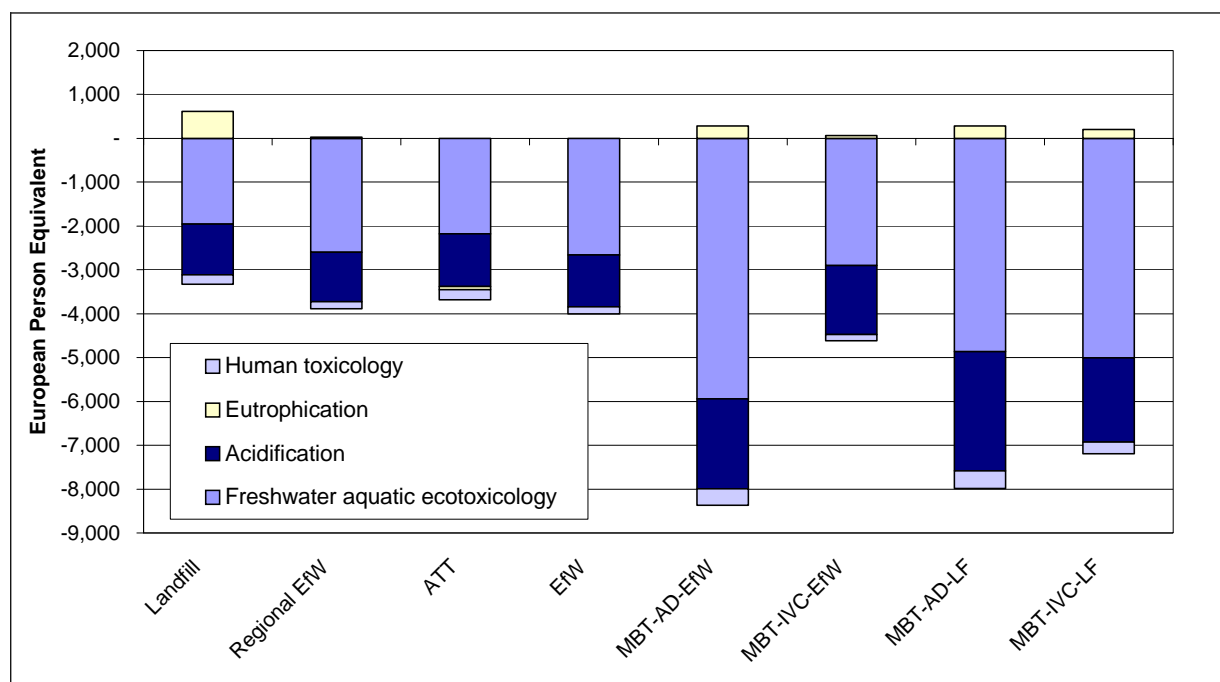
- **Human toxicity:** This indicator is a measure of the net level of potentially toxic elements which are released. It is calculated by WRATE in terms of kilograms of 1-4 dichlorobenzene equivalent.
- **Eutrophication:** The release of nutrients to surface water (e.g. via leachate from landfills) can cause eutrophication. This results in the growth of algae and subsequent oxygen depletion in the water which can have a significant effect on aquatic organisms. WRATE estimates the eutrophication impact over the lifecycle of each option in terms of kilograms of phosphate (PO₄) equivalent.

- **Acidification:** Emissions of acid gases (e.g. Nitrous oxides, sulphur dioxide and hydrogen chloride) to the atmosphere causes an effect on human health, buildings and ecosystems. This indicator is measured by WRATE in terms of equivalent kilograms of hydrogen ions.
- **Freshwater aquatic ecology:** This indicator is a measure of the net level of toxic elements which are released to aquatic ecosystems. It is calculated by WRATE in terms of kilograms of 1-4 dichlorobenzene equivalent.

4.42 The results for each of these indicators have been normalised in terms of an 'equivalent European person' (the process used in WRATE for normalising results) and grouped together to provide an overall local emissions impact (see Figure 29).

4.43 All options derive a net positive performance in terms of local emissions due to the emissions which are avoided by the recovery of materials and energy under each option. MBT-AD options perform best. MBT-IVC-LF also performs well.

Figure 29: Local Emissions

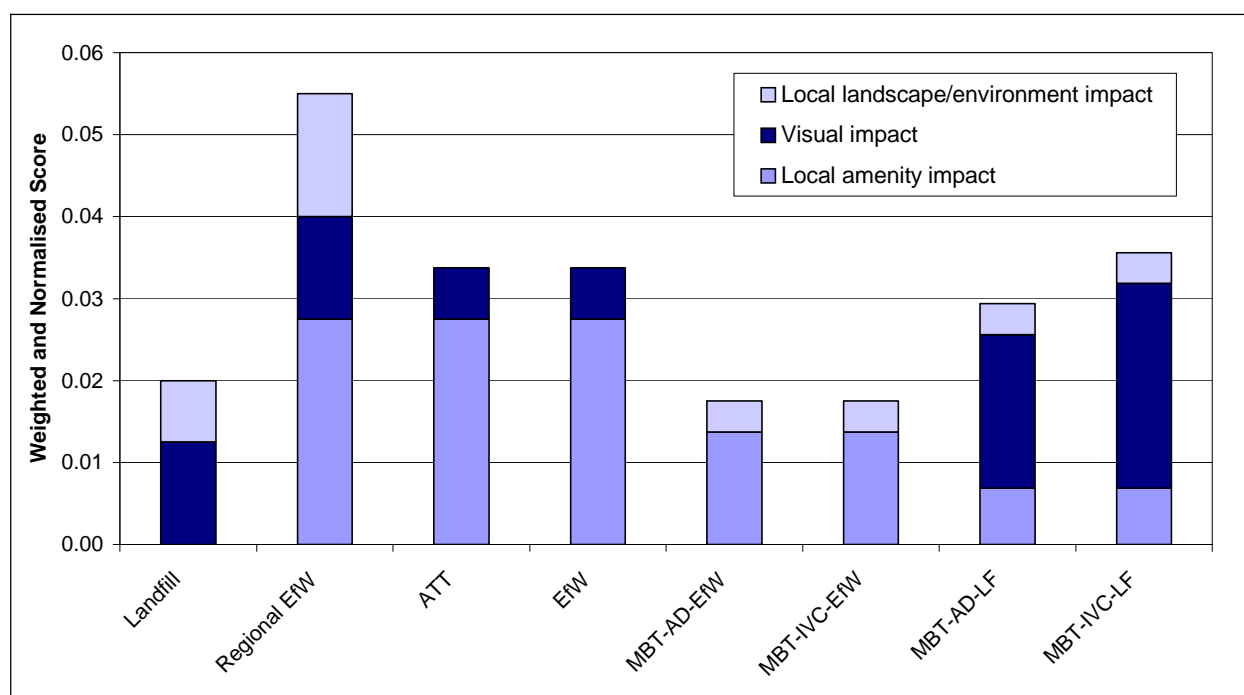


Local Impacts

4.44 The normalised and weighted scores for local landscape impact, visual impact and local amenity impact (i.e. odours, noise and dust) are illustrated in Figure 30. Regional EfW performs overall the best for these three criteria as it is considered to result in lower levels of local amenity impacts and local landscape impact.

- 4.45 The local amenity impact is considered to be most significant for landfill (which scores lowest) and is also significant for the MBT options which also score poorly for this criterion due to the typically significant odour and dust issues associated with these waste management options. EfW, ATT and Regional EfW options score well as these options typically have all their operations enclosed and as a result do not generate significant local amenity problems.
- 4.46 The visual impact of the MBT-EfW options is considered to be the most significant as two facilities are needed, including an EfW facility with a tall stack. EfW and ATT options also score relatively poorly. MBT-LF options score well for this criterion as these are typically low profile industrial buildings. MBT-IVC-LF scores better than MBT-AD-LF as it does not have the large external ADobic digestion tanks associated with the latter.
- 4.47 Those options requiring the development of facilities inside Torbay score lowest for the local landscape impact criterion as they require the development of potentially intrusive infrastructure within the Bay's sensitive environment. Regional EfW scores best as it is assumed that it would be possible to build a larger regional facility in a more suitable setting (i.e. there is flexibility to identify a location which is less environmentally sensitive, in terms of landscape and visual impact than the majority of Torbay).

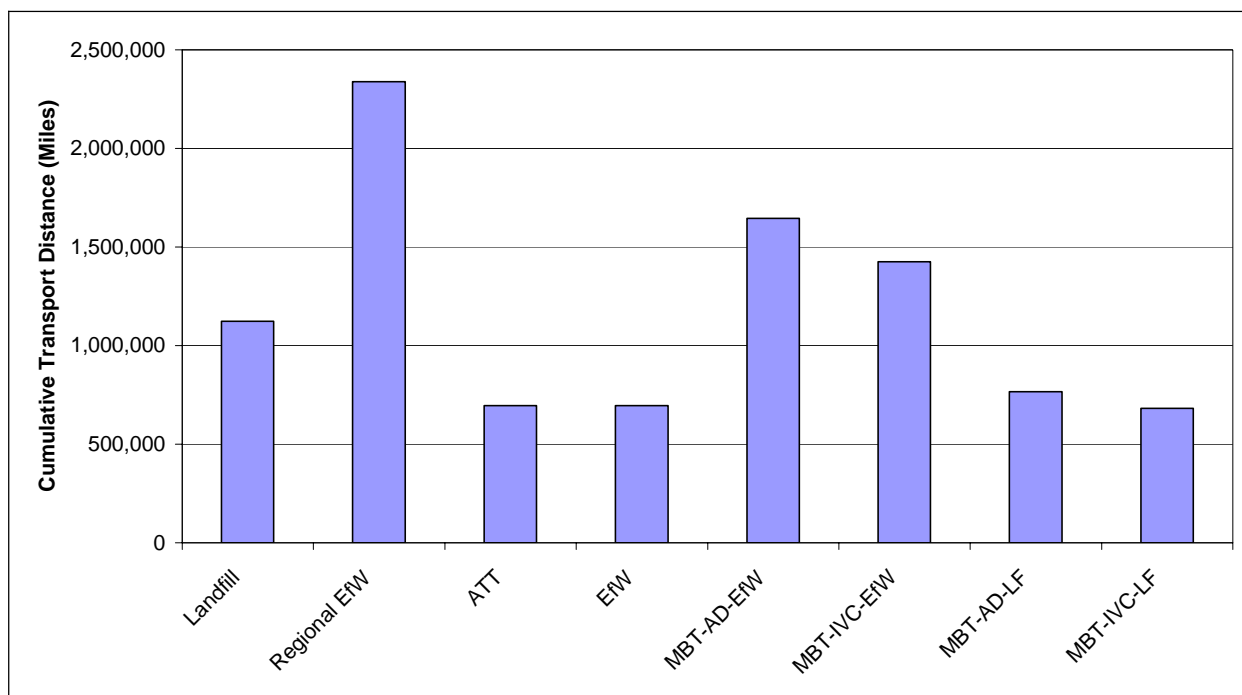
Figure 30: Local Impacts



Transport Impacts

- 4.48 Transport impacts for each option are illustrated in Figure 31. Note that for the purposes of this criterion, cumulative transport distance up to 2035 is used as a proxy for impact caused solely by road transport (e.g. noise and potential congestion caused by additional vehicle movements). The distance calculated by the transport model relates to that required to transport waste materials from the Waste Transfer Station to the point of treatment. Mileage associated with the transport of residues from treatment facility to landfill was also included. This criterion was not intended to represent greenhouse gas or other emissions associated with road transportation; these issues are captured in the Greenhouse Gas Emissions and Local Emissions criteria.
- 4.49 The Regional EfW option results in the highest mileage because under this option all MSW is transported to an EfW facility outside Torbay. MBT-EfW options also incur significant mileage due to the need to transport RDF from the MBT facility in Torbay to an EfW facility outside Torbay.
- 4.50 The ATT, EfW and MBT-LF options are associated with the lowest mileage. The mileage for the ATT and EfW options relates to that needed to transport incinerator bottom ash (IBA) and fly ash from the treatment facility to landfill. The mileage for the MBT-LF options relates to the landfill of residues from the treatment process. The quantity of residues is higher for MBT options than for the ATT and EfW options but in the case of the later two, the fly ash needs to be transported to a hazardous landfill some distance away from Torbay, resulting in similar overall mileage distances.

Figure 31: Transport Impacts

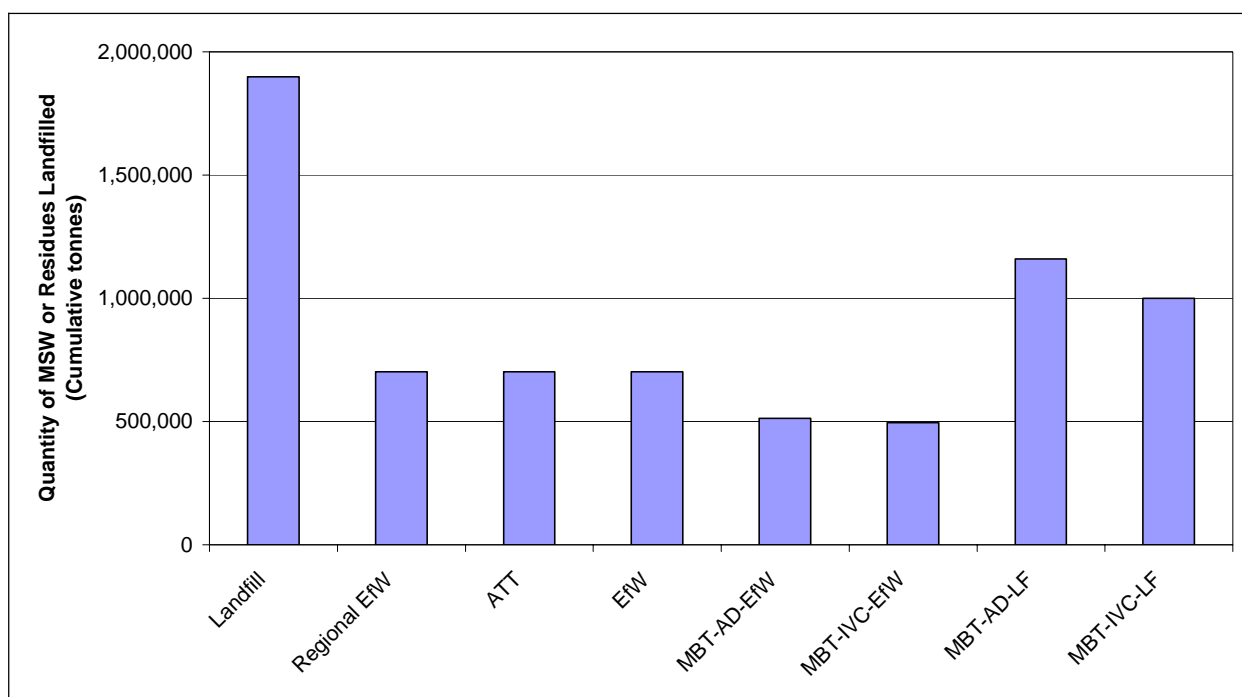


Residues to Landfill

4.51 The estimated quantity of material requiring landfill under each option up to 2035 is illustrated in Figure 32. The business as usual option is associated with the greatest quantity of landfilled material. The MBT-LF options also generate relatively large quantities of materials for landfill. Essentially, the MBT processes serves to reduce the quantity of material requiring landfill (by an estimated 55% to 65% depending upon the process employed). The reduction in mass requiring landfill relates to materials recovered for recycling and mass losses in the form of water vapour and emissions which occur during the mechanical biological treatment process.

4.52 MBT-EfW options are associated with the lowest quantity of material requiring landfill. This quantity relates primarily to the landfill of residues generated by the EfW process combusting the RDF produced by the MBT. However the MBT process will also generate some reject material which cannot be processed into an RDF and hence will require landfill. Thermal options (EfW, ATT and Regional EfW) also result in relatively low quantities of material requiring landfill.

Figure 32: Residues to Landfill



Recycling and Recovery BVPI Performance

4.53 Estimated levels of recycling and recovery performance for each option are presented in Figure 33. Performance is only considered where it is likely to meet the requirements for meeting applicable BVPI targets for recycling (BV82b) and recovery (BV82c). The values used relate to that associated with residual waste treatment infrastructure and do not take into account recycling achieved via Torbay's source-separated collection scheme, as it is assumed that recovery via these routes is the same for all options.

4.54 For instance, it is assumed that 10% of the mass treated by an MBT-IVC facility will be recycled in accordance with the definition defined under BV82b. Conversely, it is assumed that none of the material being treated by thermal processes (EfW, ATT and Regional EfW) will assist Torbay in meeting BVPI recycling targets. Material that is recovered after the combustion process (e.g. metals) does not contribute towards BV82b. As part of their process, some forms of ATT include a mechanical pre-treatment process which allows the recovery of materials before the combustion process. However, this varies between the different proprietary ATT processes so for the purposes of consistency, this report assumes a recovery level of 0% for all thermal options.

4.55 In terms of energy recovery, it is assumed that all thermal options and MBT-AD options achieve 100% recovery of all material treated by the process (i.e. it is used to generate power and potentially heat). The MBT-IVC-EfW process is assumed to achieve 45% recovery, which equates to the estimated quantity of material converted by a typical MBT-IVC process into

RDF. The RDF is then used in an EfW facility to generate power and potentially heat. Whilst it could be argued that landfilled waste does generate power through landfill gas generation systems, this form of energy recovery does not qualify under the BVPI definition of energy recovery so for the purposes of this report MBT-IVC-LF and the landfill options are assumed to achieve 0% energy recovery.

Figure 33: Recycling and Recovery Performance

Option	Recycling Performance	Recovery Performance
Landfill	0%	0%
Regional EfW	0%	100%
ATT	0%	100%
EfW	0%	100%
MBT-IVC-EfW	10%	45%
MBT-AD-EfW	10%	100%
MBT-IVC-LF	10%	0%
MBT-AD-LF	10%	100%

Site Footprint Requirement and Jobs Created

4.56 The estimated site footprint requirement for each treatment facility is summarised in Figure 34. Site footprint requirements vary significantly between different facilities, depending upon the type of technology employed and the specific design used. With innovative design and engineering, it is possible to fit a residual treatment facility on a constrained site. For example, the 65,000 tonne per year EfW facility planned for Exeter has been designed to fit on an approximately 1hectare site. The figures summarised below, represent reasonable averages for the generic technology types. Essentially, MBT processes typically require more space than equivalently sized thermal treatment systems. Furthermore, MBT processes intended to stabilise material for landfill disposal typically require a large maturation area and as a result need a larger sites than MBT processes which have been designed to produce an RDF. Infrastructure which is required outside Torbay (e.g. land required for the development of a Regional EfW or additional landfill space) has not been included in this assessment of footprint requirement.

4.57 The estimated number of jobs created by the residual waste treatment infrastructure for each option is summarised in Figure 34. The figures below provide an indication of the level of full time equivalent job creation associated with different generic residual waste treatment options. Essentially, MBT processes typically require a greater number of staff than thermal processes. Thermal processes tend to be automated to a great extent whereas MBT processes have a greater number of process stages which require materials handling operations or process monitoring. Again, it is important to recognise that the precise number of jobs created by an option will depend upon a range of factors including the technology employed and the detail of the infrastructure developed. However, these values provide an effective way for comparing options at the options appraisal stage.

Figure 34: Site Footprint Requirement and Jobs Created

Option	Estimated Number of Jobs Created (Full Time Job Equivalents)	Estimated Site Footprint Requirement (hectares)
Landfill	0	0
Regional EfW	0	0
ATT	15	2.0
EfW	15	2.0
MBT-IVC-EfW	20	2.5
MBT-AD-EfW	20	2.5
MBT-IVC-LF	20	3.0
MBT-AD-LF	20	3.0

Technical Criteria

4.58 The EfW and Regional EfW options scored highest for technical issues (see Figure 34). This is because EfW:

- 1) is a tried and tested technology with a high level of reliability;
- 2) is reasonably flexible to changes in waste composition; and
- 3) achieves a relatively high level of energy recovery (see Figure 36).

4.59 These options do not score as high as MBT options for future proofing because of the likelihood of increasingly stringent controls on the levels of efficiency demanded of EfW

options and potentially increased emission requirements. Although in the latter case it is likely that all waste management options will be required to meet increasingly stringent regulations.

- 4.60 Figure 34 provides a more detailed illustration the different energy balances associated with each option (i.e. the net balance of energy taking into account energy required to operate a process and the level of energy recovered from a process). The values illustrated have been derived from the WRATE analysis tool. In summary, EfW and Regional EfW options are associated with the greatest level of energy recovery and so perform best in terms of energy balance. MBT-IVC-LF and Landfill options have the lowest energy balance because energy generation is limited to that generated via landfill gas systems. All other options have similar moderate energy balances.

Figure 35: Summary of Technical Scores

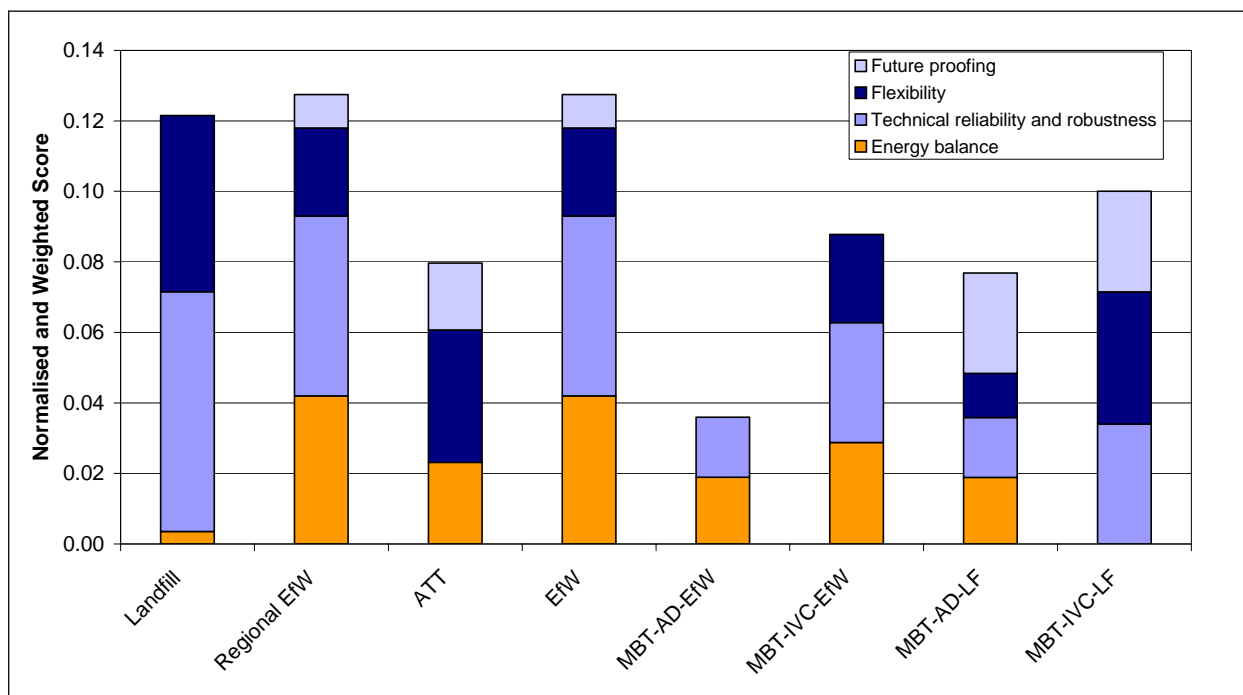
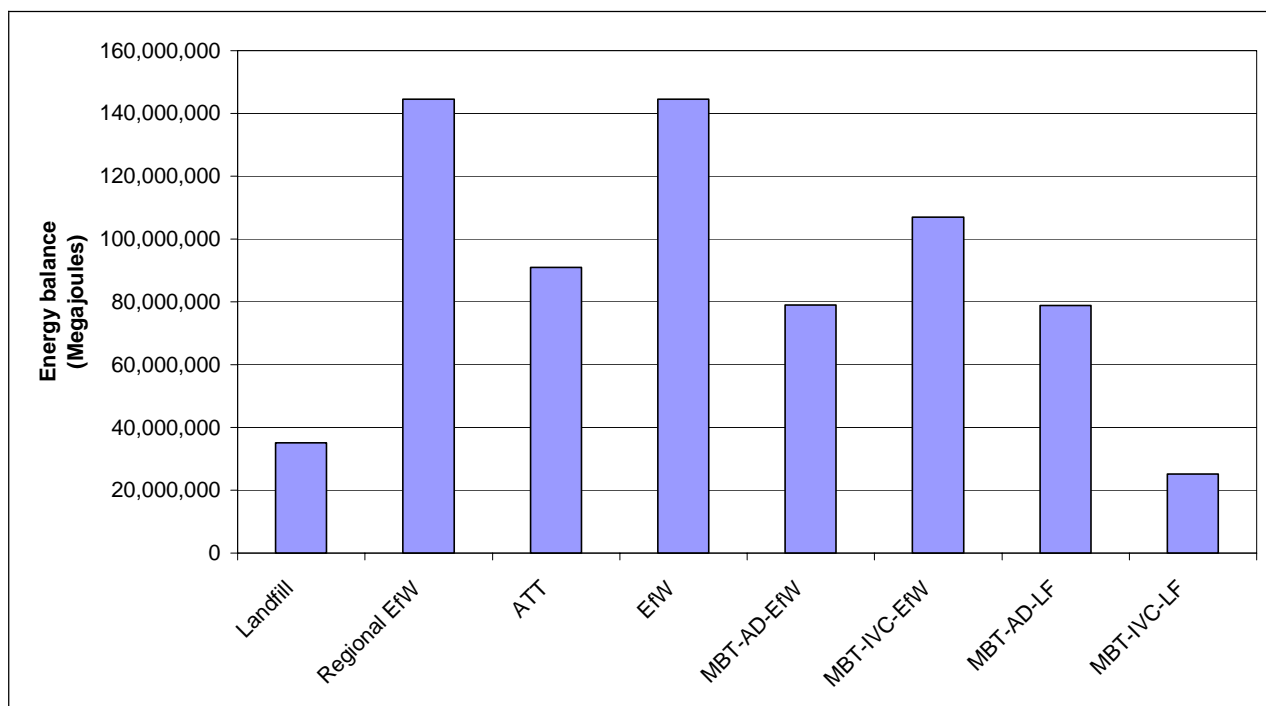


Figure 36: Energy Balance

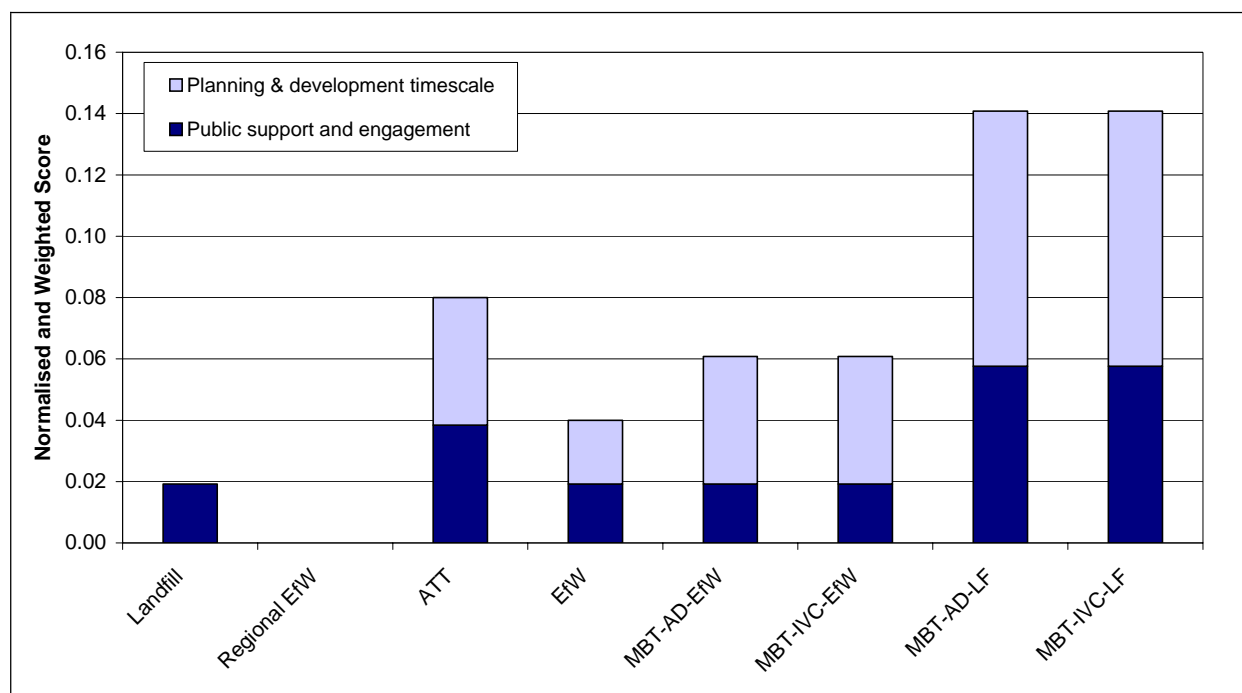


Note: Energy balance estimated using WRATE analysis tool which uses energy consumption and production data for a range of case study technologies.

Planning Risk Criteria

- 4.61 MBT-IVC options score highest in terms of planning risk (see Figure 37). In comparison to thermal treatment, MBT options typically receive less public opposition, although identification of an appropriate site will be critical regardless of technology type. Also their typically shorter construction and commissioning timescales are associated with a lower level of delivery risk.
- 4.62 Landfill and thermal options (EfW, ATT and Regional EfW) all score poorly against this set of criteria due to the long timescales associated with commissioning and the relatively high levels of public opposition, which these options typically encounter. Over the last 20 years we have seen projects take anything from 4 to 15 years from inception to delivery (see Box 2 for some examples). Whilst ATT does score slightly higher than the EfW options in terms of public support, it is still considered to be exposed to potentially high levels of public opposition.

Figure 37: Summary of Planning Risk Scores



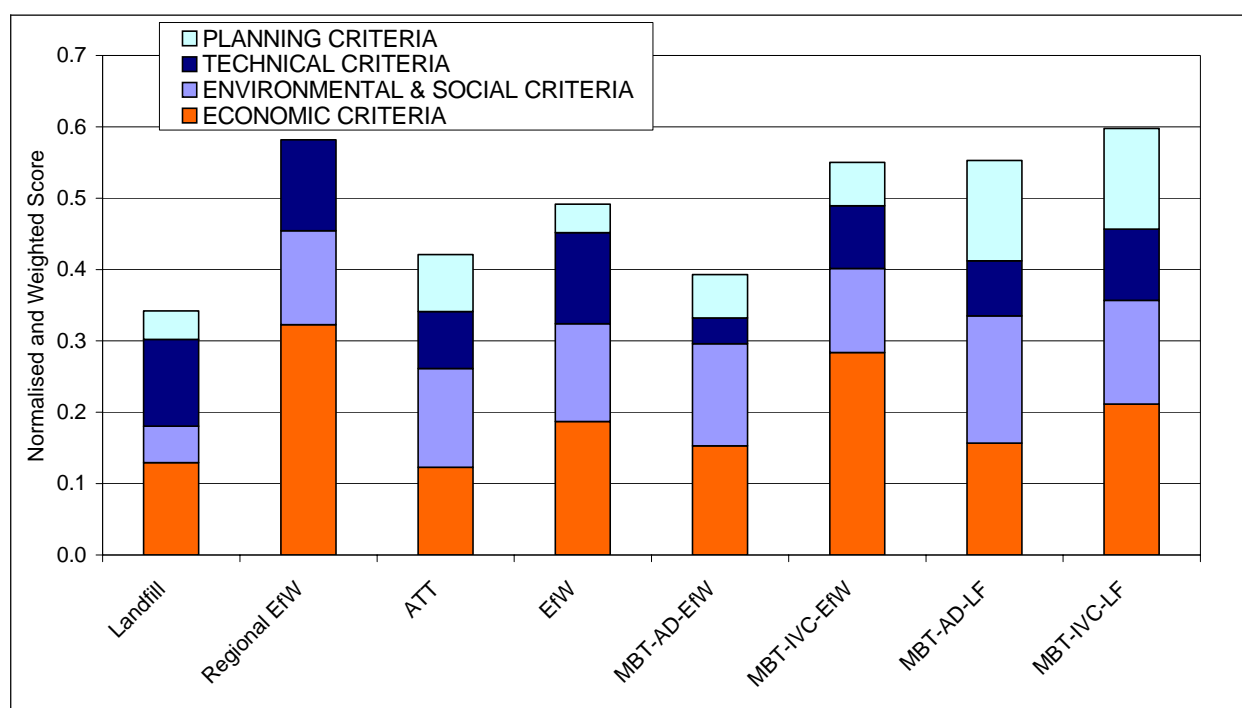
Box 2 – Examples of Planning Issues and Risks

- In 2001, applications for three EfW plants were submitted in Surrey: one for 110,000tpa at the Clockhouse Brickworks in Capel; a second in Redhill at the Copyhold Works for 225,000tpa. A third application was submitted by Thames Waste Management to process 225,000tpa at the Slyfield Industrial Estate, Guildford. The Copyhold site in Redhill was refused planning permission as it was in the Green Belt. The Capel application was accepted but then refused following judicial review. Two planning applications were made in the space of nine years at the Redhill site before the Local Planning Authority eventually unanimously rejected the applications in 2001 after a nine-year battle.
- A planning application for an EfW in Kidderminster was made in 2000. Worcestershire CC Planning and Regulatory Committee rejected the application by 11 votes to 2; however the applicants used their rights of appeal to obtain a public enquiry. The legal process took four years and the application was eventually refused.
- In 2000 Aberdeen City Council signed a 25-year contract with SITA for the collection and disposal of their household waste. This contract was to include the construction of an EfW plant. In 2001 an application to build an integrated waste management facility at the Altens Industrial Estate was submitted, which was to incorporate a MRF and an EfW plant designed to process 160,000 tonnes of residual waste per year. In 2004 the Aberdeen City Council Planning Committee granted permission to build the MRF element of the facility but consent for the EfW was refused.
- The Newlincs EfW facility has been operational since March 2004 and is one of the fastest developed EfW plants in the country. Although its capacity is 56,000 tonnes per annum (tpa) it operates at approximately 48,000tpa due to the differing calorific values of the waste. The plant only takes household waste from NE Lincolnshire and does not import any waste from other regions. NE Lincolnshire argued that the plant would meet the proximity principle, as it would only process waste from the NE Lincolnshire region, and not import waste. This was considered to be key in obtaining planning permission for the facility.

5 CONCLUSIONS

5.1 Figure 38 illustrates the results of the options appraisal process and shows how each option performs against the four types of appraisal criteria (economic; environmental and social; technical; and planning risk). In considering the results, it is important to remember that this appraisal process is not intended to provide a definitive answer. Instead it serves as a means for understanding the relative merits of different options and provides a framework for developing the way forward for Torbay. It is important also to note that the options appraisal process is sensitive to the scores and weightings applied to the different sets of criteria. Small changes in these factors will change the option with the highest score. However, the appraisal does indicate that MBT-IVC-LF, MBT-AD-LF, MBT-IVC-EfW and Regional EfW all perform well relative to other options.

Figure 38: Summary of Options Appraisal Outputs



5.2 A summary of key findings is provided below:

- The two options based upon Mechanical Biological Treatment combined with the landfilling of residues (MBT-IVC-LF and MBT-AD-LF) perform well. They score highly for all four types of criteria and are associated with moderate capital and operational costs. Development of an MBT facility in Torbay is considered to represent the best option in terms of reducing planning risk due to: 1) the greater levels of public acceptance associated with MBT; and 2) the lack of reliance upon the delivery of

infrastructure outside the Bay. However, the exact level of Torbay's LATS liabilities for these options will depend upon the performance of the specific IVC or AD technologies employed. This is because the level of biological stabilisation achieved by these technologies will determine the actual level of BMW diversion. In addition, these options are reliant upon there being landfill capacity available for residues produced by the process.

- The development of an MBT facility producing a RDF from an IVC-type process (MBT-IVC-EfW) also performs well. It has moderate capital costs, although its operational costs are estimated to be relatively high due to the potentially high gate fee for RDF. The planning risk associated with this option is considered to be higher than for MBT-LF options due to the option's reliance upon a suitable outlet for RDF being available outside the Bay. The equivalent option based upon an AD treatment process (MBT-AD-EfW) scores poorly due to its relatively poor performance in terms of technical criteria; the use of an AD process for treating MSW is not well established in the UK and is not typically used for producing an RDF.
- Whilst it has not been explicitly appraised as an option as part of this study, a hybrid of MBT-LF and MBT-EfW options would be potentially feasible. For instance, an MBT facility could be developed in the Bay producing a stabilised residue for landfill (as per MBT-IVC-LF). Then, if an outlet for an RDF were secured, the process could be modified to produce an RDF. This approach would be likely to cost more overall and would require selection of an MBT process which could be modified. However, it could have potential benefits for Torbay in that: 1) it is associated with a high level of self sufficiency in waste treatment capacity (i.e. it reduces Torbay's reliance upon waste infrastructure outside the Bay); 2) is also likely to deliver a higher level landfill diversion relative to purely EfW-based options as commissioning timescales are typically shorter; and 3) gives Torbay flexibility, dependent upon whether an outlet for RDF can be found in the medium to long term.
- The regional EfW option has the lowest level of estimated capital expenditure (purely that associated with recycling infrastructure) and as a result is the strongest option in terms of NPV. Again, this option scores well in terms of technical and environmental and social criteria. However, this option is likely to expose the Council to the highest level of planning risk, particularly as the delivery of the necessary infrastructure will be in the hands of a partner authority.
- The development of an EfW facility in the Bay is the option that is considered to ensure the highest level of self-sufficiency for Torbay. As an option it performs well in terms of technical, environmental and social criteria. It is the option with the highest estimated capital cost but the lowest operational cost (due to the high levels of revenue associated with the sale of power and potentially heat) and is a bankable

solution due to its status as a well-established, reliable technology. However, there may be a limited number of suppliers willing or able to provide an EfW facility of the relatively small scale required for Torbay. As a result, EfW scores moderately overall in terms of economic criteria. Furthermore, the EfW option scores poorly in terms of planning risk, due to the high risk of public opposition and associated delays, and the longer timescales associated with the development and commissioning of an EfW facility.

- The ATT option does not perform well overall primarily due to its poor economic performance. Whilst ATT is estimated to possess similar capital and operational cost characteristics to EfW, it has a low level of bankability (i.e. it is unlikely to attract funding from financial institutions due to its lack of track record in the UK) and there are a small number of potential suppliers of the technology in the UK.
- The business as usual option (landfill) scores lowest. This option scores well in terms of technical issues because it is a well-established technically reliable option. However, it performs poorly against economic, environmental and social, and planning risk criteria.
- A comparison of the costs in NPV terms for Recycling Option 2 and Recycling Option 3 indicates that Recycling Option 3 is more costly than Recycling Option 2 for all options. This increased cost is primarily associated with the additional capital costs for Recycling Option 3 (estimated at £6M). The effect of Recycling Option 3 on overall operational costs varies for different residual treatment options. Operational costs are higher when Recycling Option 3 is combined with EfW, ATT and MBT-LF but are lower when combined with Regional EfW and MBT-EfW options. Of course, it is important to remember that wider issues need to be considered when deciding whether to introduce Recycling Option 3, in particular its ability to increase recycling performance (by approximately 10%).

5.3 Overall, the options appraisal indicates that there is a range of viable options available to Torbay Council for the management of its residual waste and that no single option represents the clear optimal solution for the Bay. If Torbay Council wishes to determine a preferred option at this stage, careful consideration will need to be given to the options in terms of their performance against the appraisal criteria, the availability of capital (i.e. affordability), the level of importance which Torbay attributes to self-sufficiency as well as the different procurement options available to the Council.

ANNEXE A: OUTLINE DESCRIPTIONS OF RESIDUAL WASTE TREATMENT TECHNOLOGIES

A.1 Energy from Waste (EfW)

EfW is a term used to describe technologies capable of energy recovery. EfW is broadly categorised by two technology groups:

- Traditional or conventional combustion plants; and,
- ATT technologies.

Conventionally thermal treatment involves the processing of MSW by combustion with no or minimal treatment to the feedstock, although in today's context the waste will have been subjected to some recycling and hence is residual waste. Incineration generally destroys about 70% of the input waste leaving about 25-30% as IBA and up to 4% as fly ash or Air Pollution Control (APC) residues. Other outputs include wastewater, flue gases and energy.

IBA may be refined to recover ferrous and non-ferrous metals, although their poor quality is unlikely to generate significant revenue from their sale, moreover they would not count towards BVPI recycling or recovery targets. Non-metallic minerals can also be recovered from IBA for use in aggregates for construction and if uses cannot be identified disposal to landfill may be required. APC residues must be disposed of in a landfill licensed to accept hazardous waste and as few hazardous waste landfills exist disposal is costly and likely to become more so.

EfW plants have typically been built with capacities in excess of 100,000 tpa due to the high costs of smaller plants. However with the increasing costs of landfill, smaller plants below 100,000 tpa are starting to become cost competitive. An EfW plant may offer the ability to meet LATS requirements with minimal risk compared to other technology options. Suitable integration of EfW plants allows for optimum energy efficiency through the utilisation of heat produced, for example through combined heat and power (CHP). Waste heat produced may be utilised in a district heating scheme or in industrial applications, although this would be dictated by location. An EfW facility with a good quality CHP scheme will qualify for Renewable Obligations Certificates thus providing a greater level of income.

A.2 Advanced Thermal Treatment (ATT)

ATT refers to those technologies, including pyrolysis and gasification, which occur as a sub-process to combustion and which, if operated separately, are seen as offering a more efficient method of thermal treatment. ATT is being more commonly considered as an alternative to traditional incineration.

ATT options are yet to make a real breakthrough in terms of costs and bankability given their emerging nature, although several large gasification plants processing MSW operate in Japan. In the UK there are no current commercial MSW operations although there are plans for plants to be developed. Energos also has several plants operating in the EU that are considered to be ATT and have plans for plants in the UK.

The energy generated from ATT has the advantage of qualifying for Renewables Obligation Certificates (ROCs) and is thus capable of generating a higher energy price. The recent Waste Strategy Review also indicates that ATT would qualify for double ROCs making this a particularly valuable source of revenue. However, the renewables obligation is a market-based instrument so energy prices are not guaranteed in the long term and consequently this poses a market risk.

A.2.1 Pyrolysis involves the heating of waste in the absence of oxygen at high temperatures. Pyrolysis produces an energy rich gas (syngas), liquid oils and a carbon rich char. The gas may be combusted to produce steam, or if of sufficient quality may be cleaned and fired directly in a conventional gas engine for electricity production. Pyrolysis produces high levels of residues in terms of char and liquid hydrocarbons that require further treatment or disposal. Pyrolysis may precede gasification.

A.2.2 Gasification operates at a higher temperature than pyrolysis and involves the controlled addition of oxygen, although not at levels expected for complete combustion. A syngas of lower heating value is produced and a lower quantity of some tars, char and ash than could be expected from pyrolysis. The gas may be used for direct firing in kilns, boilers or to aid combustion in a conventional furnace. If the gas is of suitable quality it may be used as an engine fuel.

A.3 Mechanical Biological Treatment

Mechanical biological treatment plants treat residual waste after the removal of source separated recyclable and compostable materials. The screening of MSW prior to biological treatment allows for additional removal of recyclable material. The mechanical and biological stages may be varied and the order in which they are achieved may be altered. MBT plants are available in modular design, allowing them to be designed to a required capacity. The size of the modules however would impact the resultant capacity of the plant. Possible MBT processes are discussed below.

A.5.1 MBT with In-Vessel Composting MBT (MBT-IVC) is essentially the same as BMT (biodrying) although IVC aims to achieve a higher level of degradation producing a Compost Like Output (CLO). In general, the waste entering the system is screened and mechanically processed to recover large combustible items such as cardboard and plastic, which are either recycled or used to create a low grade RDF. Further processing removes metals and

other non-combustible materials, for example glass. The remaining fraction is then composted, which may take place in two stages where an additional screening phase is used between two composting stages. Alternatively the screening and removal of recyclable components can be undertaken following the composting process. The compliance of IVC in terms of LATS requirements would need to be assessed, although as with any biological treatment a contribution to BMW diversion would be made.

A.5.2 MBT with Anaerobic Digestion (MBT-AD) AD is the breakdown of organic material by micro-organisms in the absence of free oxygen producing methane and carbon dioxide. The use of AD in the wastewater industry is an established practice although over the last 20 years the number of AD plants treating MSW has risen across Europe and worldwide.

Its application in treatment of MSW in the UK is limited. However, there are a number of demonstration and full-scale facilities under development. Due to the inherent variability of the composition of MSW the challenges associated with AD tend to be associated with the need for appropriate pre-treatment of waste materials. There may also be a need for aerobic maturation of outputs materials following their anaerobic treatment.

The quality of the output from AD is also feedstock quality dependent. Thus, in the case of MSW, it is unlikely that contracts would be secured for application to land. As such, the outputs would require further treatment via EfW, or disposal to landfill, which could impact on LATS targets. Similarly, biogas quality depends on the quality of the organic feed, and the degree of digestion. Generally power generation from biogas would be by way of modular gas engines within a CHP plant to supply both heat and power to the facility with surplus power being sold to the local supply network.

A.4 Pre-treatment to Produce Refuse Derived Fuel

A form of MBT could be used to generate a fuel for use in an EfW plant. This type of process is often referred to as MBT, because of the typical orientation of the biological and mechanical treatment components. The biological stage results in a reduced moisture content, partial bio-stabilisation and lower pathogen presence. The mechanical stage facilitates the capture of non-combustible wastes, which can all be recovered for recycling in compliance with BVPI criteria.

There are two main types of fuel which can be produced by this process: 1) a simple RDF which is normally produced by rapidly drying MSW to reduce its moisture content (often called biodrying); and 2) a more refined Solid Recovered Fuel (SRF), produced by extracting high calorific value materials such (paper, card, plastic, etc) from MSW. Advantages of combining EfW with MBT could potentially include:

- A smaller sized EfW plant (approximately half the capacity of a standalone EfW plant)
- Reduced tonne miles of waste haulage to the EfW plant
- Improved BVPI performance on recycling
- Reduced ash to landfill
- Potential higher thermal efficiency or heat utilisation via the use of the fuel in a regional EfW plant or third party facility such as a cement kiln
- The exportation of the fuel to an EfW plant would negate the need for construction and associated costs

A.5 Autoclaving – Energy from Waste (EfW)

A fuel product could also be generated via an autoclave. AC uses hot water or steam to degrade cellulose based materials whilst sterilising other components. The degradation of the cellulose based materials results in a fibrous mass, which can then be used in an EfW plant. AC also helps in the removal of recyclables from the waste stream and can increase the value of glass and metal components due to them having been sterilised and to some extent “cleaned”.

As with BMT, the use of AC followed by exportation of waste to an existing EfW facility would reduce transport costs due to reduced volume and negate the need for EfW infrastructure. AC is considered to be a new technology and there are currently no commercial plants operating on MSW in the UK.

A.5.1 Autoclaving with Anaerobic Digestion (AC-AD) The digestion of MSW can potentially be improved through pre-treatment using AC. As previously discussed, AC sanitises waste and aids in the removal of recyclables. Additionally, AC facilitates digestion as the cell structure of the biogenic fraction is broken down. As a result AC-AD would increase BMW diversion towards LATS compliance. A drawback to this hybrid configuration is the necessity to build two plants, ideally co-located to minimise transport.

ANNEXE B : OUTCOME OF WASTE ANALYSIS WORKSHOP

RPS has been working with Torbay Council to develop a shortlist of potential options for the future management of Torbay’s municipal waste. In overview, the shortlist comprises 5 potential solutions:

Option 1	Option 2	Option 3
Energy from Waste Outside Torbay	MBT In Torbay	MBT In Torbay
Residues to Landfill Outside Torbay	Residues to Landfill Outside Torbay	RDF to EfW Outside Torbay
Option 4	Option 5	
ATT In Torbay	Energy from Waste In Torbay	<u>Key:</u> ATT: Advanced Thermal Treatment EfW: Energy from waste MBT: Mechanical Biological Treatment RDF: Refuse Derived Fuel
Residues to Landfill Outside Torbay	Residues to Landfill Outside Torbay	

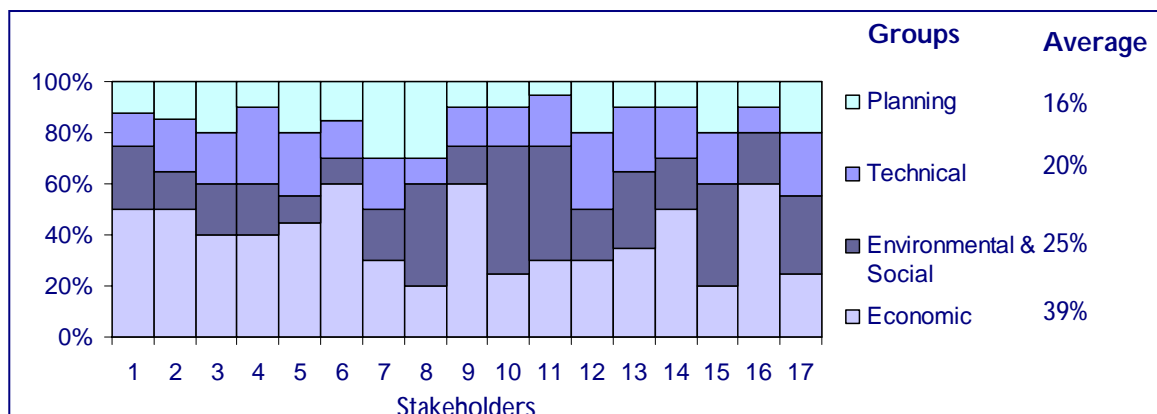
On 4th June, RPS ran a waste analysis workshop with the following objectives:

- To raise participants’ understanding of waste treatment technologies;
- To discuss the potential planning, technical, environmental, social and economic issues associated with the technologies;
- To establish a set of appraisal criteria against which each of the waste management options could be appraised;
- To invite participants to allocate weightings to each of these criteria.

Presentations were delivered by RPS on waste treatment options and the shortlist, and attendees participated in a workshop to develop the final list of criteria. Once these were agreed, participants were asked to provide a breakdown of weightings for the 4 headline groups (Planning, Technical, Environmental & social and Economic). These are presented in Step 1 over the page. Participants were then sent a breakdown of the agreed criteria and requested to allocate weightings within each group (Step 2). The total allocations (of 100%) were then calculated for the entire set of criteria.

This information will contribute to the decision-making process the waste managers of Torbay are undertaking. The results of the consultation are presented in summary form over the page.

Step 1: Allocating weightings to *groups* of criteria



Step 2: Allocating weightings *within* groups of criteria

	% Allocation <i>within</i> groups of criteria			Total stakeholder allocation (of 100%)
	High	Low	Average	
PLANNING CRITERIA				16%
Public support and engagement	70%	20%	48%	8%
Planning & development timescale	80%	30%	52%	8%
TECHNICAL CRITERIA				20%
Energy balance	40%	10%	21%	4%
Technical reliability and robustness	70%	10%	35%	7%
Flexibility	50%	10%	25%	5%
Future proofing	40%	10%	19%	4%
ENVIRONMENTAL & SOCIAL CRITERIA				25%
Greenhouse gas emissions	50%	3%	17%	4%
Local emissions	20%	5%	11%	3%
Local amenity impacts	18%	5%	12%	3%
Visual impact (not site-dependent)	15%	5%	9%	2%
Local landscape/environmental impact	20%	0%	7%	2%
Transport impacts and accessibility	15%	0%	9%	2%
Jobs created	10%	0%	5%	1%
Residues to landfill	30%	5%	10%	3%
Recycling BVPI	20%	3%	8%	2%
Energy recovery BVPI	12%	0%	6%	2%
Site footprint requirements	15%	0%	5%	1%
ECONOMIC CRITERIA				39%
Cost	70%	10%	34%	13%
Bankability	60%	10%	22%	9%
LATS compliance	50%	10%	26%	10%
Adequate market capacity/suppliers	30%	10%	18%	7%
				100%

ANNEXE C: OPTIONS APPRAISAL MATRIX

	Weighting	Unit	Weighted and Normalised Score							
			Landfill	Regional EFW	ATT	EFW	MBT-AD-EFW	MBT-IVC-EFW	MBT-AD-LF	MBT-IVC-LF
ECONOMIC CRITERIA	39%		0.130	0.323	0.123	0.187	0.153	0.284	0.157	0.212
Cost	13%	Net Present Value (£)	0.044	0.127	0.000	0.000	0.000	0.109	0.095	0.129
Bankability	9%	Qualitative	0.086	0.064	0.000	0.064	0.021	0.043	0.000	0.021
LATS compliance	11%	Qualitative	0.000	0.079	0.105	0.105	0.079	0.079	0.026	0.026
Adequate market capacity/suppliers	7%	Qualitative	0.000	0.053	0.018	0.018	0.053	0.053	0.035	0.035
ENVIRONMENTAL & SOCIAL CRITERIA	25%		0.051	0.132	0.139	0.137	0.148	0.125	0.184	0.145
Greenhouse gas emissions	4%	Global Warming Potential (WRATE)	0.000	0.015	0.017	0.019	0.020	0.012	0.040	0.019
Local emissions	3%	WRATE indicators	0.000	0.013	0.013	0.010	0.024	0.012	0.028	0.015
Local amenity impacts	3%	Qualitative	0.000	0.028	0.028	0.028	0.014	0.014	0.007	0.007
Visual impact (not site-dependent)	3%	Qualitative	0.013	0.013	0.006	0.006	0.000	0.000	0.019	0.025
Local landscape/environmental impact	2%	Qualitative	0.008	0.015	0.000	0.000	0.004	0.004	0.004	0.004
Transport impacts and accessibility	3%	Total mileage (up to 2035)	0.018	0.000	0.025	0.025	0.010	0.014	0.024	0.025
Jobs created	1%	Full time job equivalents (in Torbay)	0.000	0.000	0.009	0.009	0.013	0.013	0.013	0.013
Residues to landfill	3%	Total tonnes (up to 2035)	0.000	0.021	0.021	0.021	0.025	0.025	0.013	0.016
Recycling BVPI	2%	Materials recovered (%)	0.000	0.000	0.000	0.000	0.023	0.023	0.023	0.023
Energy recovery BVPI	2%	Energy recovered (%)	0.000	0.015	0.015	0.015	0.015	0.007	0.015	0.000
Site footprint requirements	1%	Hectares	0.013	0.013	0.004	0.004	0.002	0.002	0.000	0.000
TECHNICAL CRITERIA	20%		0.122	0.128	0.080	0.128	0.036	0.088	0.077	0.100
Energy balance	4%	Megajoules (WRATE)	0.004	0.042	0.023	0.042	0.019	0.029	0.019	0.000
Technical reliability and robustness	7%	Qualitative	0.068	0.051	0.000	0.051	0.017	0.034	0.017	0.034
Flexibility	5%	Qualitative	0.050	0.025	0.038	0.025	0.000	0.025	0.013	0.038
Future proofing	4%	Qualitative	0.000	0.010	0.019	0.010	0.000	0.000	0.029	0.029
PLANNING CRITERIA	16%		0.019	0.000	0.080	0.040	0.061	0.061	0.141	0.141
Public support and engagement	8%	Qualitative	0.019	0.000	0.038	0.019	0.019	0.019	0.058	0.058
Planning & development timescale	8%	Qualitative	0.000	0.000	0.042	0.021	0.042	0.042	0.083	0.083
Total	100%		0.321	0.582	0.421	0.492	0.398	0.557	0.558	0.598



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