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Newcastle City Council

Portfolio: Environment and Sustainability

Executive

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Municipal Waste Management – Residual Waste Treatment

Report by: **EXECUTIVE DIRECTOR OF REGENERATION AND ENVIRONMENT**

Ward Implications **ALL**

Please indicate For Decision		

1. **Summary**

1.1 The Council's Municipal Waste Management Strategy (MWMS) was agreed by Executive at its meeting in September 2007. This was developed in response to the Council's obligations under the Landfill Allowance Trading Scheme (LATS) in addition to its long term aspiration of achieving zero waste.

1.2 At its meeting Executive agreed the integrated waste and recycling service currently being rolled out across the City. Whilst these services will further improve the current recycling/composting rate of 33% they will not be sufficient to protect the Council from future LATS financial penalties.

1.3 To address the situation the Council now needs to move to the next stage and decide what technology(s) should be adopted to treat the remaining residual waste left over after recycling and composting has taken place. Any investment will need to be procured and commissioned by 2012/13 in order to avoid the risk of incurring significant LATS penalties.

The purpose of this report is, therefore, to complete the implementation of the MWMS by agreeing:

- the scale of residual waste treatment that is required to meet medium and long term LATS targets (see section 4),
- which technologies should be explored to place the Council in the best possible position to achieve its objectives (see sections 5 and 6); and
- the need to undertake a procurement exercise to secure access to an appropriate waste technology (s) (see section 7)

2. **Recommendation**

2.1 Executive are recommended to agree the following:

1. That a waste facility or facilities capable of treating 40,000 tonnes of residual waste a year is needed by the Council by 2012/13 at the latest.
2. That the range of potential waste technology solutions to be explored should include-

   - advanced thermal treatment with energy recovery
   - autoclaving followed by further treatment
   - incineration with energy recovery
   - and the production and use of Solid Recovered Fuel (SRF).
3. That the Council carry out a procurement exercise to secure such a facility/facilities from the range of technology types confirmed above, and that a further report be brought to Procurement Committee dealing with the detail of the procurement exercise.
4. That Executive receive a further report on completion of the procurement process to approve both the council's future partner and technology solution.

3. Background

3.1 Executive agreed in March 2007 the following targets for City Council's MWMS.

- 5% reduction and reuse of household waste by 2010.
- 15% reduction and reuse of household waste by 2020.
- 43% recycling and composting of household waste by 2010.
- at least 55% recycling and composting of household waste by 2020.
- 43% recovery of municipal waste by 2010.
- at least 75% recovery of municipal waste by 2020.

These targets reflect the Strategic Environmental Assessment (SEA) on the Councils draft MWMS that was subject to public consultation in early 2007.

3.2 Executive agreed a new integrated recycling and waste collection service in September 2007. As a consequence 54,000 households now have garden waste collections and over 100,000 households are having their black box replaced with a blue bin for recycling. This implementation will be completed by 31 March 2009. The new service will build on sustained performance improvement in recent years. Household waste recycling and composting rose to 33.5% in 2007/8 from a base of less than 4% in 2001/02 (Appendix 1).

3.3 The Council is on track to meet both our LATS target for 2009/10 and our MWMS target of 43% recycling by a combination of.

- The existing Mechanical Biological Treatment (MBT) technology

under contract with SITA to 2024.
- The new integrated collection service.
- Other recycling initiatives.

This existing infrastructure will continue to underpin the MWMS for the foreseeable future.

3.4 However this improved performance will not be enough to meet LATS targets beyond 2009/10 and we will risk financial penalties if further improvement is not secured (Appendix 2). The SEA process found that there are practical limits to how much waste can be recycled and composted. It, therefore, suggests that some residual waste treatment is needed even taking into account current challenging waste minimisation targets. Those Core Cities that currently send less waste to landfill than Newcastle and are on track to meet their LATS targets have already invested in residual waste technologies, mainly incineration (Appendix 3).

3.5 There are two key decisions that need to be taken in order to identify the best option for Newcastle.

1. The amount of residual treatment needed to meet medium and long term LATS obligations.

2. Which treatment technology or technologies best fit our strategic objectives and are complementary to existing infrastructure and contractual commitments.

These decisions are not mutually exclusive. The decision on the scale of treatment needed is a factor in the choice of treatment technology. This is because some technologies are not technically or financially workable at certain scales. This is covered in more detail in Section 5.

4. Key Decision 1 – Scale of Residual Waste Treatment

4.1 The method used to evaluate this considers the impact of 3 variables on LATS targets.

1. Projections of how much municipal waste the City will produce.
2. The level of recycling, composting and recovery that can be expected from existing infrastructure.
3. Different levels of additional residual waste treatment.

4.2 How Much Waste Will the City Produce?

The Council has responsibility for handling just over 171,000 tonnes of municipal waste in 2007/8. It is not possible for a number of reasons to accurately predict how this might change in the future. This is confirmed by an analysis of waste arisings since 1993/94 (Appendix 4.) This shows significant fluctuation with a difference of 30,000 tonnes (18%) between highest and lowest points. The National Waste Strategy (2007) predicts growth of 0.5% a year which is down from 3% a year in the previous national strategy (2000). The trend in Newcastle is gradually downwards, but the potential for future significant fluctuation remains.

There are a number of factors that appear to influence this including.

- **Changes in population and household numbers –** our ambitions to increase households and economic activity will potentially increase the amount of waste produced.
- **Consumer purchasing practices** – changing patterns of consumption influence waste types and quantities such as the home computing boom increasing waste paper.
- **The link between general economic prosperity and waste production** – the National Waste Strategy recognises that waste production mirrors the economic cycle and seeks to decouple this**.**
- **Less commercial waste being collected by the Council -** due to changing market conditions and competitiveness.
- **Impact of service changes -** in particular increasing waste storage capacity for households. For example the steep rise in waste produced between 1998 and 2000 evident in Appendix 4 is attributable to wheelie bins replacing bags in refuse collection. There was a similar smaller rise in 2003-4 when black boxes were introduced. This could be important as the new integrated waste and recycling service will increase waste storage capacity significantly.
- **Impact of national and local initiatives around waste minimisation.**

Clearly we only have direct influence over some of these factors and we need to recognise and factor in the risks of not being in full control of this issue.

4.3 Four scenarios for municipal waste production are modelled to take account of these possible variations (which are also shown on the graph in Appendix 4):

- Scenario 1 - 0.5% growth a year as projected in the National Waste Strategy for England 2007.
- Scenario 2 – our current waste reduction targets set out in section 3.1. The SEA recognised that these reduction targets are extremely challenging to deliver and represent the "best case" scenario that it is reasonable to aim for.
- Scenario 3 – waste allocated to Newcastle in the waste apportionment study commissioned by the Regional Assembly to inform the Regional Spatial Strategy (RSS). This is equivalent to just over 1% growth a year and is the "worst case" scenario.
- Scenario 4 –remaining static at 2007/8 levels.

There is a difference of around 46,000 tonnes between the best and worst case scenarios by 2019/20.

4.4 **How much diversion can be expected from existing infrastructure?**

For each of the four growth scenarios, two possible projections for diversion from existing infrastructure have been modelled.

- Maintaining the expected diversion rate of existing infrastructure up to 2020. This includes the MBT process meeting contractual targets and the new collection services having a better performance than predicted in the report agreed by Executive in September 2007.
- A "continual improvement" projection that includes year on year increases from the new collection services and other recycling facilities. This reflects the Councils target of recycling/composting at least 55% household waste by 2020.

4.5 **What are the impacts of additional residual waste treatment?**

We have modelled five options for different levels of residual waste treatment with the four growth scenarios in 4.3 and two diversion projections in 4.4.

4.6 **Evaluation of Options for Scale of Waste Treatment**

1. **10,000 tonnes of residual waste treatment starting in 2009/10** – it is recommended that this option be discounted as it will not meet LATS targets in any circumstances.
2. **40,000 tonnes of residual waste treatment starting in 2012/13** – this would meet LATS targets in 2012/13 except in the worst case scenario for waste growth. It meets 2019/20 targets in the best case scenario or in circumstances in which waste remains static but diversion performance improves.
3. **40,000 tonnes of additional waste treatment starting in 2012/13 and then a further 40,000 tonnes becoming available in 2017/18** – this would meet both 2012/13 and 2019/20 targets in all circumstances but would likely mean we would be investing in surplus capacity than we need.
4. **50,000 tonnes of residual waste treatment starting in 2012/13** – this meets LATS targets in 2012/13 in all circumstances and also achieves the 2019/20 targets if waste strategy reduction targets are met and there is no increase in diversion rates.
5. **10,000 tonnes of additional residual waste treatment starting in 2009/10 and then a further 70,000 starting 2013/14** – meets all targets but would likely mean we would have more capacity than we need.

These have been assessed against the ability to meet LATS targets up to 2020. This information is summarised in appendices 5 – 9.

4.7 **Preferred Option**

Based on the analysis of these options, **Option 4** offers the greatest degree of confidence for meeting all LATS target years and performance levels without the risk of building a facility with greater capacity than required.

However, as a result of the Council's commitment to delivering the waste minimisation, re-use and recycling targets in the MWMS, it is recommended that **Option 2** be selected i.e. develop 40,000 tonnes of residual waste treatment capacity to be fully operational by 2012/13. This would allow us to meet LATS obligations in that target year and meet the 2019/20 targets if;

- our MWMS reduction targets are achieved; or
- waste growth remains static and continual improvements to existing infrastructure are made.

If it does not prove possible to meet waste reduction targets due to influences outside the control of the Council or recycling performance from existing infrastructure does not improve sufficiently then additional residual treatment capacity could be considered at a later date.

This additional treatment capacity would not need to come on line until around 2017/18. Therefore any decision to develop further treatment capacity, bearing in mind the lead in time for the development of facilities, would need to be taken around 2012/13.

This approach is the most flexible in terms of balancing the definite LATS pressures in 2012/13 with the longer term uncertainties of waste production and recycling levels. It leaves significant scope for increasing landfill diversion from improving recycling schemes in the future to meet the 55% recycling/composting target for 2020.

5. Key Decision 2 – Choice of Residual Waste Treatment Technology

5.1 The other key decision to be taken is the choice of treatment technology that fits best with the anticipated scale of residual treatment needed above, overall policy objectives and compatibility with existing waste management infrastructure and contractual obligations. The SEA completed in early 2007 considered 6 **generic** technology types. These technologies are considered already proven or nearing market acceptability in terms of their technical performance, reliability and confidence in attracting investment. They are:

- Advanced thermal treatment (gasification/pyrolysis)
- Anaerobic digestion
- Autoclaving
- Energy from Waste Incineration

- MBT
- Production of Solid Recovered Fuel (SRF) and its use

It should be noted that there are a range of specific technologies within each these generic technology types each with different detailed impacts and outcomes with the broader parameters of each group. A description of technologies examined during the study tour is given in appendix 10 as illustrations of the generic technology types.

5.2 Members, officers and representatives of Ban Waste undertook a study tour in March and April 2008 to view learn from others and help assess a range of representative residual treatment technologies from each of the generic technology types. The study tour was independently facilitated and conducted with the following objectives in mind:

- to act as a fact finding mission and inform the decision making process;
- to enable delegates to visit representative examples of waste treatment technologies with which might play a role in delivering the strategy;
- to view waste technologies at first hand, to gauge practical issues such as the size and scale of operations, location of facilities and visual impacts; and
- to develop the knowledge base on waste technologies by providing a forum through which delegates could debate, discuss and raise questions.

In total 5 facilities were visited. The itinerary is given in Appendix 11 (with the visit in respect of SRF use being cancelled due to unforeseen circumstances) All of these treated residual waste with the exception of the anaerobic digestion plant which handled food and garden waste.

5.3 The evaluation of the different technologies involves:

- testing compatibility with the existing waste management infrastructure in which investment has already been made and/or contractual commitments exist. This includes collection services and the MBT;
- assessing the environmental impacts of the different technologies (including human health and global warming) including using the Environment Agency's life-cycle analysis tool (WRATE); and
- modelling of projected costs and impacts on budgets (covered in Section 6.1 below)

5.4 **Compatibility with the existing waste management infrastructure**

The current MBT system became operational at Byker and Ellington in January 2006. It is delivered under the contract with SITA signed in 2000 which lasts until 2024. The process separates out the organic part of domestic waste. Refuse collected from green wheelie bins passes though a mechanised process that sorts out organic material. which is then treated at a composting facility at Ellington in Northumberland. Metal cans are also separated out. When running to expected contractual performance the system will divert around 30,000 tonnes from landfill. This is expected in 2009/10 when outstanding operational issues have been resolved.

The MBT process underpins the Councils ability to meet the requirements of LATS in the first target year in 2009/10. Whilst performance of the MBT and other existing services is insufficient to meet targets beyond 2010/11, it will remain a crucial component part of our ability to meet landfill diversion obligations in the longer-term.

The MBT contract with SITA is also a cost effective method of treatment compared to the expected cost of other technologies. We currently pay c.£40 per tonne for MBT which compares well with similar facilities elsewhere and the anticipated c. £70-90 per tonne for other alternatives.

As a consequence early termination of this contract is not in our best interests. Such an approach would also result in penalty costs exceeding £12M.

Therefore it is recommended that the Council develop additional residual treatment technology around the existing MBT process for practical, financial and contractual reasons.

The compatibility of the different technologies with MBT is as follows.

- **Anaerobic digestion** – this process is suited to treating either separately collected or mechanically separated organic waste. Therefore it is an alternative, rather than a compatible addition to the existing MBT process. The quality and hence value of the resulting residues would be highly questionable given the level of organics already removed. In this context anaerobic digestion should be discounted as a residual treatment technology.
- **Autoclaving -** the compatibility of autoclaving is also questionable as much of its value comes from treating organic waste and recyclables that will have largely been removed by existing infrastructure. Treating the residual waste from the MBT process via autoclaving is possible, but would have less value than if unsorted waste is processed. The remaining organic element after autoclaving would still require further treatment in another technology to realise any significant LATS value, as a fuel in power generation for example. Whilst not a 'best fit' technology it should not be discounted outright at this stage.
- **SRF production -** is more compatible than autoclaving as this would require a relatively simple further treatment to produce SRF from the residual waste from the existing MBT operation. However, to be beneficial to LATS it would be necessary to secure a viable end-market for the SRF. Using SRF in cement kilns was identified during the study tour. However this market favours contracts limited to around 5 years, so there would be risks to long-term provision with this option.

- **Advanced thermal treatment** – is compatible with the MBT residues but different variations of advanced thermal treatment technologies may require this waste to be further treated. This could be a separate 'fuel' production operation similar to SRF above or a simple shredding process onsite like the type of gasification technology visited on the study tour.
- **Energy from waste incineration -** could treat residual waste from the MBT directly and is compatible.

It is recommended that Anaerobic Digestion not to be pursued as a potential technology in view of its incompatibility with the existing MBT process.

5.5 Assessment of the environmental impacts

All methods of treating waste, whether it be recycling, composting, recovery or landfill have environmental consequences. It is important to note that it is unlikely that there will ever be a consensus on how to assess these. Environmental issues also need to be assessed alongside other factors such as cost. As a result, trade-offs between environmental and other factors will be inevitable in this decision making process.

The environmental impacts of the different technology options have been evaluated using 2 two methods:

1. WRATE; and
2. Literature reviews on what are considered to be two key environmental issues – **health** and **climate** change.

5.6 WRATE

WRATE (Waste and Resources Assessment Tool for the Environment) is a Life Cycle Assessment (LCA) software tool for comparing different waste management systems. It has been used to predict the environmental impacts of the different residual waste management options. WRATE is publicly owned by the Environment Agency who state that whilst "there are other LCA tools; however, none offer the same scope of waste technologies that are provided by WRATE or have the level of sophistication of technical development".

However it needs to be noted that WRATE, like any LCA tool, has limitations. In particular, only a site-specific study into environmental impacts is likely to result in a true accurate like-for-like comparisons of treatment technologies. As this analysis is not site specific at this stage and indicative technologies have been used, WRATE should only be regarded as an aid to the decision making process.

WRATE calculates potential impacts from all stages in the management process including collection, transportation and treatment. It also takes account of positive environmental impacts such as material recycling and energy recovery.

The system models 6 key environmental impact categories.

- Global warming (production of greenhouse gasses).
- Human toxicity (effect on human health).
- Abiotic resource depletion (use or saving of natural resources including fossil fuels).
- Eutrophication (excess nutrients that can harm water environments).
- Acidification (i.e. causing ‘acid rain’).
- Freshwater aquatic ecotoxicity (toxic chemicals that can harm rivers and lakes)

It measures both the positive and negative aspects of each technology against these categories and expresses them as the impacts caused by the equivalent number of people. . A more detailed explanation of how WRATE works is given in Appendix 12.

The existing situation with residues from the MBT going to landfill is modelled then replaced 40,000 tonnes of this residual waste being sent to the following technologies.

- Advanced thermal treatment (gasification).
- Autoclaving followed by power generation.
- Energy from waste incineration.
- SRF production followed by use of the fuel in cement kilns.

Specific technologies as close as possible to those visited during the study tour have been input into WRATE. It has not been used to evaluate anaerobic digestion as the system confirms this is incompatible in treating residual waste from the MBT process (as outlined in 5.4 above).

Results

The headline results of the WRATE analysis are given in Appendix 13. All of the technologies would have a net positive environmental impact compared to the baseline position, although to different overall levels and between the different impact categories.

Table 1 - Summary of WRATE Results.

Technology	Comments
advanced thermal treatment (gasification)	Ranked **third** out of four for total net impacts. **Best** for human toxicity and eutrophication .
autoclaving followed by power generation	Ranked **fourth** out of four for total net impacts. **Worst** for abiotic resource depletion, freshwater aquatic ecotoxicty and human toxicity
energy from waste incineration	Ranked **second** out of four for total net impacts. **Best** for freshwater aquatic ecotoxicity and **worst** for global warming and acidification.
SRF production followed by use of the fuel in cement kilns	Ranked **first** out of four for total net impacts. **Best** for abiotic resource depletion, global warming and acidification and **worst** for eutrophication. The WRATE results for this technology are around 5 times better than the next best technology. Abiotic resource depletion has a particularly good score. Further analysis indicates this is a result of the SRF replacing coal as a fuel in cement kilns.

The scale of the of the environmental impacts however are relatively low in the context of the City and how it is likely to change. The technology with the best net impact is equivalent to moving around 12,000 people **out** of the City. The worst technology in respect of global warming is equivalent to **bringing in** around 500 people. The impact of technologies on human toxicity range from **bringing in** between 116 and 68 people. . Clearly this analysis suggests other changes in the City, particularly the aspiration to grow the City's population, will have much greater overall environmental impact than implementation of the waste strategy.

In order to compare like with like, the WRATE analysis is based on technologies being located in the City and with standard short travel distances between the MBT and the new technology. In reality this is unlikely to be the case for some technologies, the use of SRF in cement kilns being the most obvious example. Therefore the full environmental benefits and burdens of some technologies may not impact Newcastle itself.

5.7 Literature review - Health

This review (in Appendix 14) concentrates on a report commissioned by the Department of Environment Food and Rural Affairs on the health effects of managing municipal waste.

The review's main finding is that whilst the information is not complete, the weight of evidence is that modern waste management practices have at most a minor effect on human health. There are significant potential impacts of not managing waste however such as disease, odours, litters and pests.

Keys issues is respect of different technologies are:

- Incineration produces the greatest emissions of oxides of nitrogen, followed by pyrolysis/gasification and landfill.
- Composting produces the highest emissions of particulates. Incineration is also an important source.
- Sulphur dioxide emissions are similar for all processes involving burning or decomposing waste.
- Hydrogen chloride and hydrogen fluoride emissions are higher from processes where waste or waste gases are burnt. Incineration is the biggest source of hydrogen chloride.
- Volatile Organic Compound emissions are likely to be greater from landfill, composting and MBT than from combustion processes.
- Methane emissions are highest from landfill.
- Landfill is the only significant source of emissions to sewer, surface water and groundwater.
- Other than landfill, all of the processes result in other outputs. These may be useful products (e.g. compost or the digested material from an anaerobic digestion facility). Materials recycling facilities produce materials which are sent for reprocessing into useable products.
- Emissions of dioxins and furans are highest from incineration. Advanced thermal treatment has lower emissions.

Work comparing dioxin emissions is given in Appendix 15. This was examined in more detail as are often concerns about this substance in particular. The research available mostly concerns dioxin releases from incinerators. Emissions of dioxins from incinerators can increase levels of dioxins in soil, although the present generation of incinerators release much smaller amounts of dioxins than was the case. Dioxins from an incinerator in an industrial environment will only slightly increase the total deposition of dioxins. Increases in dioxin levels in cleaner rural environments will be relatively higher but would not be expected to be a concern with regard to health.

5.9 Literature review - Climate Change

This review (Appendix 16) looked at the production of greenhouse gases from different waste technologies. Best performing technology combinations included MBT or autoclave followed by gasification. Landfill was by far the worst, followed by incineration.

6. Evaluation Outcome

All of the technologies are similar in respect of the key issues of.

- Having a net environmental benefit compared to landfilling residual waste as we do now.

- Cost.
- Landfill diversion and contribution to LATS.

All are broadly compatible with existing infrastructure, although autoclaving is clearly weakest in this respect. Salient issues for each technology on other key matters are as follows.

6.1 Advanced Thermal Treatment (gasification)

- It has similar landfill diversion performance to incineration and SRF use.
- It is a modular technology that can be delivered cost-effectively at the scale needed (40K tonnes).
- The associated benefits of combined heat and power could be realised in the City and support carbon reduction targets.
- It is compatible with existing infrastructure and could treat residual waste from the MBT process with limited additional processing.
- It has comparatively better environmental performance than other forms of thermal treatment.
- Whilst an emerging technology in the UK (the first operational plant on the Isle of Wight due to open in 2009), the study tour identified that it is proven operationally elsewhere supplying low carbon heat through district heating networks.

6.2 Autoclaving followed by power generation

- It has worse landfill diversion performance compared to advanced thermal treatment, incineration and use of SRF due to the value of organic waste and recyclables having already been extracted by existing infrastructure.
- It is an emerging technology in the UK, with no commercial scale plants treating municipal waste operating, but several are planned or under development.
- Further treatment in one of the other alterative technologies or as a fuel elsewhere would need to be added to realise any significant LATS benefits. This may be achievable at a similar cost to other technologies but would require more movement of waste.
- It appears to have the least environmental benefits overall.

6.3 **Energy from Waste Incineration**

- It has high landfill diversion rates and low outputs to landfill.
- It is compatible with existing infrastructure and could treat residual waste from the MBT process directly.
- It is tried and tested technology with the least operational risks.
- It has relatively poor environmental performance in key areas.
- Efw incineration at the recommended scale of 40,000 tpa is unlikely to be delivered at an affordable rate (in comparison to other treatment options). The optimum size for cost effective efw incineration is, around 150,000 – 200,000 tonnes. Delivering this technology would probably require the City to work with other authorities or waste management companies that operate or may in future operate such facilities.
- The City would only benefit from the associated carbon reduction benefits of combined heat and power if such a large scale facility was located in relatively close proximity to key regeneration areas which is probably incompatible.
- Considering the fact that a stand alone incinerator of 40,000 tonnes would not be viable, it is highly unlikely that incineration within the boundaries of Newcastle is possible.

6.4 **SRF production followed by use of the fuel in cement kilns.**

- It has similar landfill diversion performance to advanced thermal treatment and incineration.
- It is compatible with existing infrastructure and could treat residual waste from the MBT process with some additional processing.
- There is no market for SRF in the City at present. If the Council were to favour this technology we must either seek to promote and facilitate developments using SRF in the City or accept that SRF is likely to be moved longer distances, with the resulting environmental consequences.
- The production and export of SRF to cement kilns would mean we would lose the benefits of localised heat and power generation.
- Contracts for using SRF in cement kilns likely only to be short to medium term.
- It appears to have the greatest overall environmental benefits, but it is unlikely that these would be realised within the City.

6.5 **Technology conclusions**

The technology types have different strengths and weaknesses, but other than anaerobic digestion none significant enough to either indicate a clear preference or rule out a particular technology. The evaluation of the technologies does not point to one technology being markedly superior to the other, although autoclaving appears to be the weakest. Environmental consequences are particularly important, but it is difficult to draw a clear conclusion in this respect based on generic technologies due to the following issues:

- whilst representative technologies have been chosen, there may be a significant range of environmental impacts with each technology group and between how integrated systems using more than one technology could be constructed ;
- We do not know at this stage which technologies the market would be able to provide;
- We do not know at this stage which locations and transport will have a significant impact on environmental emissions.

An accurate, objective evaluation of technologies is likely only to come from an assessment of what the market is capable of delivering. The decision, therefore, on the most appropriate technology for the Council needs to be undertaken on the conclusion of the procurement exercise proposed.

It is recommended the Council explore a facility/facilities based on advanced thermal treatment with energy recovery; autoclaving followed by further treatment; or incineration with energy recovery and the production and use of solid recovered fuel.

7. Corporate Implications

7.1 Financial

Price Waterhouse Coopers (PWC) were engaged to advise on the financial modelling undertaken. The report reflects their views. The financial analysis of the options highlights the following salient points.

- The amount of waste produced is the factor with the greatest impact on future costs.
- The costs of waste treatment will inevitably rise whichever approach is pursued and this will cause inherent pressure on the Councils budgetary position.
- The cost of the “do nothing” option is projected to rise from the current c. £65 per tonne now to at least £100 per tonne to 2020 (driven by the escalation in landfill tax (£48 per tonne by 2011).
- The cost of alternative to treatment technologies appears to fall within a fairly narrow band of c. £70-90 per tonne. These costs are based on information from DEFRA and soft market testing. However it must be noted that these costs are indicative and subject to change. PWC have suggested that while these costs are indicative of existing infrastructure, actual cost of delivery may reach a ceiling of £100 per tonne. The actual cost of delivery will only be determined through procurement.
- The narrow cost banding of technologies means that the proportion of

biodegradable waste diverted from landfill, thereby minimising landfill tax and saving LATS permit costs, is of relatively greater significance.

The market value of LATS will have a significant effect on the actual cost of delivering the strategy. However is there is not a significant difference between the costs of the alternative technologies. It is recognised nationally that it is not possible to predict accurately what this value might be at any point in the future. At present the LATS permits have near zero value as there is enough landfill diversion happening across the country for targets to be met. The Audit Commission's report "Well Disposed" (September 2008) states that short term landfill diversion targets are likely to be met, but the medium and longer term picture is less certain. This is likely to stimulate the market for LATS and the value of permits. The maximum value of LATS penalties / credits is £150 per tonne. It should be noted that the LATS scheme runs until 2020 and there is no indication yet as to whether the scheme will continue after that. It is reasonable to assume however that landfill diversion rates will have to remain at least at 2020 LATS levels to ensure continuing compliance with European legislation and targets.

The 2008/9 budget for waste disposal is c.£10.4m. The projected costs of the different technology choices for the preferred scenario, taking what are consider reasonable assumptions on future value of LATS and landfill tax is summarised in table 2 below and in more detail in Appendix 17. This shows financial advantages for most of the different technology options over the 'do nothing' scenario of up to c£1m, except for incineration which has almost identical costs.

Table 2 – Projected costs of preferred scenario - LATS Value £50/t in 2012/13 and £85 in 2019/20, Landfill Tax to £72/t by 2013/14, 2.5% pa increase thereafter

Technology	2012/13	2019/20	Total 2009/10 -2019/20
Baseline	£14,540,000	£15,862,000	£162,010,000
Advanced Thermal Treatment	£14,528,000	£15,599,000	£160,082,000
Autoclaving	£13,856,000	£14,787,000	£154,129,000
Incineration	£14,791,000	£15,909,000	£162,369,000
SRF	£14,213,000	£15,215,000	£157,260,000

However Table 3 and Appendix 18 shows that if LATS has no value then the baseline 'do nothing' option is marginally cheaper than incineration and advanced thermal treatment, but still more expensive than SRF and autoclaving.

Table 3 – Projected costs of preferred scenario - LATS no value, Landfill Tax to £72/t by 2013/14, 2.5% pa increase thereafter

Technology	2012/13	2019/20	Total2009/10-2019/20
Baseline	£14,042,000	£15,309,000	£157,498,000
Advanced Thermal Treatment	£14,528,000	£15,599,000	£159,958,000
Autoclaving	£13,856,042	£14,787,000	£154,004,000
Incineration	£14,791,000	£15,909,000	£162,244,000
SRF	£14,213,000	£15,215,000	£157,135,000

The Audit Commission have attempted to gain some insight into this in their report "Well Disposed". This concludes that national LATS targets for 20012/13 will only be met if all waste disposal infrastructure currently planned, including a number of major PFI projects, are delivered to timetable. Experience shows that this is unlikely to be the case and it is probable that there will be a shortfall, and therefore a value to LATS permits. Clearly there remains a significant risk associated with the value of LATS, but it is one that can not be quantified accurately at this time, particularly beyond 20012/13.

Table 4 and Appendix 19 show the impact of gates fees for the technologies at the suggested £100 per tonne ceiling in 2009/10 inflated by 2.5% per annum thereafter. The 'do nothing' option would be cheaper that all other options in this case by between c. £500K and £1m each year.

Table 4 – Projected costs of preferred scenario - LATS Value £50/t in 2012/13 and £85 in 2019/20, Landfill Tax to £72/t by 2013/14, 2.5% pa increase thereafter, standard ceiling gate fee

Technology	2012/13	2019/20	Total2009/10-2019/20
Baseline	£14,540,000	£15,862,000	£162,010,00
Advanced Thermal Treatment	£15,524,000	£16,783,000	£168,784,000
Autoclaving	£15,294,000	£16,496,000	£166,688,000
Incineration	£15,566,000	£16,830,883	£169,142,000
SRF	£15,131,000	£16,307,000	£165,283,000

We will make best endeavours to minimise the amount of waste produced and maximise the amount of waste recycled to meet the targets set. However there remains a risk of these targets not being met as of some critical influencing factors including those set out in section 4.2 are outside the direct control of the Council . The financial consequences of waste levels remain static rather than reducing and recycling staying at expected 2009/10 levels are model in Table 5 and Appendix 20. This shows that the baseline 'do nothing' scenario becomes significantly more expensive than all the technology options. Whilst remaining committed to meeting reduction and minimisation targets, it is clear that investing in residual waste treatment to the level recommended will mitigate this risk significantly.

Table 5 – Projected costs of static waste levels and recycling performance - LATS Value £50/t in 2012/13 and £85 in 2019/20, Landfill Tax to £72/t by 2013/14, 2.5% pa increase thereafter

Technology	2012/13	2019/20	Total2009/10-2019/20
Baseline	£16,205,000	£21,791,000	£191,757,000
Advanced Thermal Treatment	£15,149,000	£19,361,000	£176,681,000
Autoclaving	£14,575,000	£18,991,000	£173,303,000
Incineration	£15,412,000	£19,671,000	£178,967,000
SRF	£14,834,000	£17,327,000	£168,270,000

The overall conclusions that can be drawn from this analysis are:

- Minimising the amount of waste the Council has to deal should be considered a key priority to reduce the financial risks to the authority;
- The unit cost of residual waste treatment will rise due to fiscal factors outside the Councils control (landfill tax and LATS);
- It is not possible to accurately predict the scale of this increase as this will be dependant upon the key variables the amount of waste produced and value of LATS.
- The implementation of alternatives to the do nothing option would mitigate the extent of this budget pressure;
- There is relatively minor variation in the unit cost of the different technology options to the extent that these financial costs should not be of overriding importance in making the technology choice. Actual costs of the technology will only be identified through procurement.
- Investing in residual treatment in any of the form identified will significantly mitigate the financial implications of not being able to reduce waste production or increase recycling performance.

As well as uncertainties around waste volumes and LATS, the exact unit price for the recommended technology will only be set by the outcome of the necessary procurement processes and these figures should be considered indicative at this stage.

Taking into account the financial risks, alongside the potential reputational damage of not meeting LATS targets and the higher environmental burden of current landfill compared to the alternatives, it is recommended that we do not rely on a 'do-nothing' trading strategy for meeting our LATS targets and invest in the appropriate treatment technology identified through a procurement process.

The duration of the contract eventually entered into will be identified by the market and dependant upon a range of factors including the technology choice. PWC indicate that in order to be value for money, the duration of such a contract is not likely to be less than 12 years. Some residual waste contracts in other authorities span 25-30years. In the longer term the authority will need to review the MBT contract beyond 2024 particularly if the term of the residual waste contract goes beyond 2024 and the MBT is a dependant component of the overall approach.

There are opportunities for collaboration on procurements in the waste field but they are limited in respect of residual waste treatment as there are constrained by existing contracts and procurement processes in neighbouring authorities and their compatibility with the recommended approach for the City.

7.2 **Any additional views of City Treasurer**

The City Treasurer has been consulted on this report.

7.3 **Legal**

The Head of Legal Services has been consulted on this report. The proposed procurement exercise will need to be dealt with in accordance with the Public Contract Regulations 2006 and will necessitate an OJEU notice. The issue of which procurement route under the Regulations is most appropriate in this case will be addressed as part of the process of drawing up the Council's technical specification. However, at the present time, it is envisaged that this procurement is likely to use the competitive dialogue process. The proposals in this report are compliant with the requirements of human rights legislation.

7.4 **Environmental and Sustainability**

The development of the waste management strategy is a key component of the Sustainability Charter and Environmental Action Plan and its implementation will make a major contribution towards Corporate environmental sustainability objectives.

7.5 **Risk**

The key risks in relation to delivering the waste management strategy are identified and managed through the Neighbourhood Service risk register. The latest update is given in Appendix 20.

7.6 **Equalities**

This report does not result in the need for an Equality Impact and Needs Assessment. For access to the equalities policy please click below.

7.7 **Ward, Community Impact and Engagement Implications**

This impacts on all wards.

7.8 **Scrutiny**

The appropriate Scrutiny Committee is Environmental Impact Scrutiny Panel The panel considered the issue on 15th July 2008, 9th September 2008 and

13th January 2009.

7.9 **Partnership**

This decision does not result in the creation of a new partnership, although such a partnership may result from the procurement exercise. Performance on municipal waste diverted from landfill is a key indicator in the Sustainable Communities Strategy and the Local Area Agreement. Performance is monitored through the Housing and Environment Partnership.

8. **What Happens Next**

8.1 The Council will need to move quickly to deliver the recommended preferred option on time. The key areas needing immediate action are in respect of:

- **Planning and permitting** - this decision will be fed into the process for the Local Development Framework to ensure that that the planning and land use implications of the strategy are taken into account. It should be noted that the market may come forward with proposals within and outside of Newcastle. Any necessary applications to the planning authority and the environment agency would be made when the development proposal in terms of site and technology specification is clear. It is likely that these processes will take a minimum of two years.
- **Procurement** – this decision needs firstly to be translated into an technical specification and taken through the appropriate OJEU procedures. The procurement process is likely to take 18 months-2 years from the date the specification is prepared. It may be possible to progress some aspects of the planning and procurement processes in parallel.
- **Budgets** – whilst the actual cost of the preferred option will not be known until the procurement process in completed, the estimated increased costs should be factored into the budgetary process at this stage.

The Council may miss its LATs targets between 2009/10 and the new facility being delivered in 20012/13. It is prudent for the authority to explore what interim arrangements the market may be able to deliver during this period as part of this procurement.

The Council will require access to landfill in both the interim and the long term. There are is no landfill in Newcastle and there may be economies of scale in working with other neighbouring authorities. The Council current landfill contract runs out in December 2009 and procuring replacement arrangements with the Tyne and Wear Waste Partnership has been agreed in principle.

9. Further Information

9.1 (Background Papers:- held by Les Clark on file.)

SEA Final Environmental Report February 2007.

Executive Report 21st March 2007 - Outcome of the Strategic Environmental Assessment of the Waste Management Strategy.

Executive Report 26th September 2007 - Progress on the Waste Management Strategy

Contact Officer:- Les Clark, Head of Sustainability, 2773636

Rob Nichols, Head of Environmental Services, 2773509

Glossary

Abiotic Resource depletion – A measure used in WRATE. This impact category indicator is related to extraction of scarce minerals and fossil fuels. The scale of the impact is based on the remaining reserves and rate of extraction.

Acidification - A measure used in WRATE. Acidic gases such as sulphur dioxide (SO2) react with water in the atmosphere to form “acid rain”, which can cause environmental damage.

Advanced Thermal Treatment (ATT) - a technology uses heat to treat waste but does not burn it directly like incineration. There are two types of ATT; gasification and pyrolysis. Both processes usually work by heating up the waste in controlled conditions. This produces gases which are burned to generate electricity. The heat produced during this process can also be recovered.

Anaerobic digestion – a technology is a biological process in which organic waste is broken down by micro-organisms. This is done inside containers without any oxygen present. The process produces a gas called ‘biogas’, as well as liquids and solids called ‘digestate’. The biogas can be burnt on-site to produce electricity and heat. The digestate can be used as a fertiliser or compost.

Autoclaving – this technology works like a pressure cooker using high temperature steam to ‘cook’ waste and kill harmful germs. It also cleans materials like cans and bottles, which can then be sorted out and recycled. This leaves a fibrous material which can be used to make building materials, such as roof tiles, turned into fuel or sent to landfill.

Biodegradable Municipal Waste (BMW)– the organic part of the municipal waste that Councils collect. This is the waste that rots in landfill sites and causes environmental pollution.

Eutrophication – A measure used in WRATE. Some substances like nitrates and phosphates can encourage excessive growth of algae, reducing the oxygen within the water and damaging ecosystems.

Freshwater aquatic ecotoxicity - A measure used in WRATE. The emission of some substances can have impacts on ecosystems. This category measures the exposure and effects of substances released on the freshwater environment eg. rivers and lakes.

Household waste - waste from a household and includes wheelie bin collection rounds, recycling collections, bulky waste collections, litter bin and street cleaning, and waste taken by the public to Recycling Centres.

Human toxicity- A measure used in WRATE. The emission of some substances that can have impacts on human health.

Incineration – a technology that burns waste to produce energy which is used to generate electricity and can be used to produce heat. Wheelie bin waste can go directly to incineration.

In-vessel composting - speeds up the natural composting process by controlling heat and moisture inside containers (tunnels are proposed). The heat generated kills of germs and other harmful elements in the material. The Government only allow composting in-vessel of any waste that may have meat in it (ie household kitchen waste).

Global warming - A measure used in WRATE. Is caused by the release of "greenhouse gases" such as carbon dioxide (CO2).

Landfill Allowance Trading Scheme (LATS) – system introduced by the Government in 2005/6 to ensure the UK meetings its obligations under the EU Landfill Directive. The National target is to reduce Biodegradable Municipal Waste sent to land fill to 33% of 1995 levels by 2020. Local Authorities have been set strict allowances for landfill each year to 2020. Authorities that landfill more than their allowance can either trade permits that other authorities have spare or face a penalty fine of £150 per tonne.

Local Development Framework (LDF) – The new statutory land-use and transportation planning framework being introduced in Newcastle. The system was brought in by the Planning and Compulsory Purchase Act 2004 and replaces the Unitary Development Plan.

Material Recovery Facility (MRF) – a facility that sorts out materials that have been collected for recycling.

Mechanical Biological Treatment (MBT) – a technology that separates out and treats the organic part of residual waste. In Newcastle residual waste from wheelie bin collections sorts out organic material which is sent for in-vessel composting. Steel and aluminium cans are also separated out.

Municipal Solid Waste (MSW) - all waste collected by the Council ie. household waste plus commercial waste and parks and gardens waste collected by the local authority.

Organic waste – natural material like grass cuttings, vegetable peeling and other garden and food waste that can be turned into compost.

Residual waste - waste left over that is not recycled or composted.

Solid Recovered Fuel (SRF) – a process that makes fuel pellets from residual waste that can be used instead of fossil fuels like coal in power stations, cement kilns etc.

WRATE – a computer tool used to predict the environmental impacts of different waste treatment methods.

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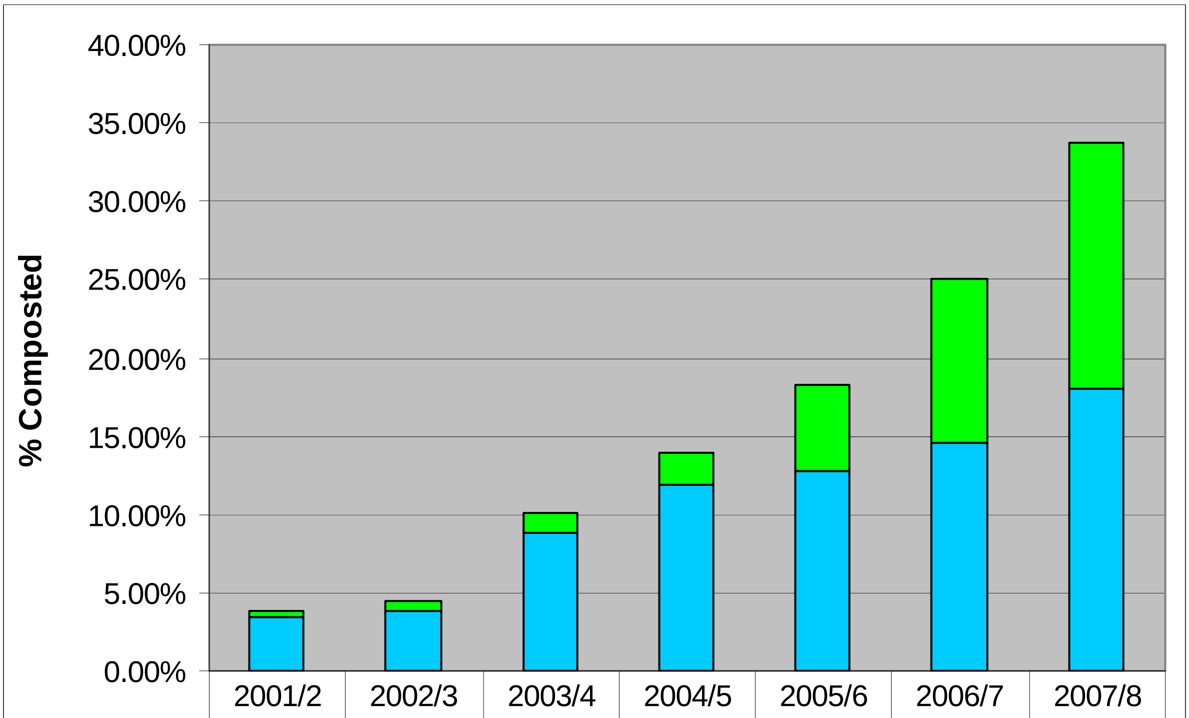
Appendix 21	Extract from Neighbourhood Services Risk Register November 2008

Appendix 1

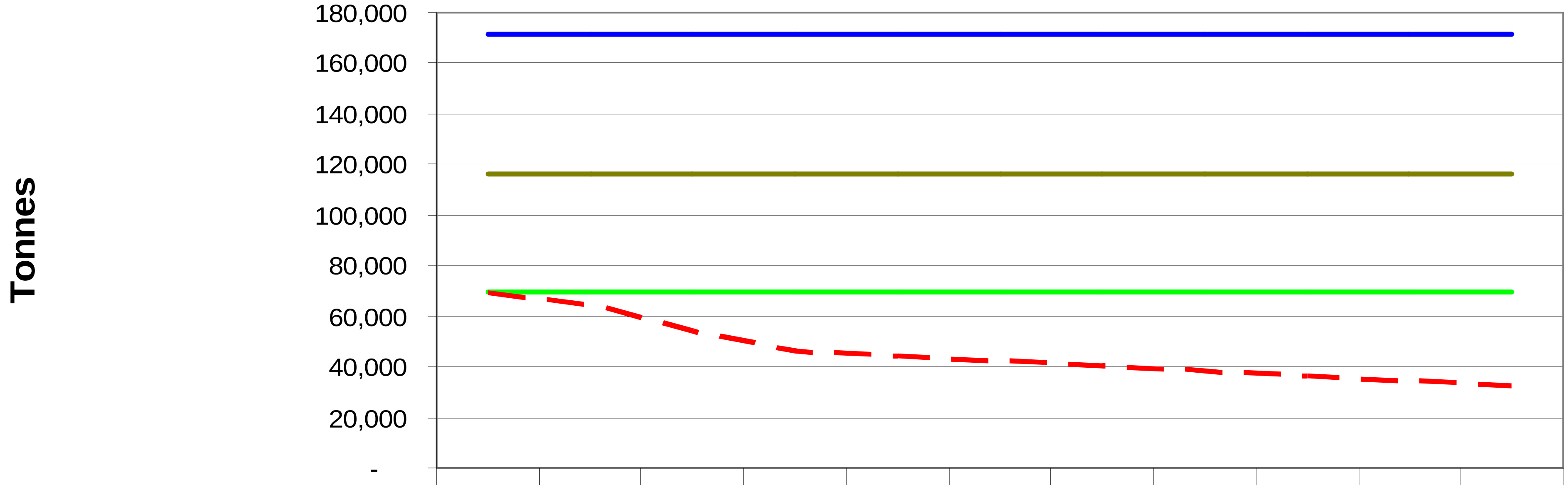
Improvement in Recycling and Composting Performance 2001/2 – 2007/8



	2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8
Composting	0.44%	0.61%	1.33%	2.05%	5.51%	10.54%	15.77%
Recycling	3.45%	3.88%	8.79%	11.83%	12.77%	14.53%	18.00%

Year

Appendix 2
LATS Projections to 2019 / 20 of Baseline Position



	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Total MSW - Static	171,158	171,158	171,158	171,158	171,158	171,158	171,158	171,158	171,158	171,158	171,158
Total BMW	116,388	116,388	116,388	116,388	116,388	116,388	116,388	116,388	116,388	116,388	116,388
BMW Landfilled	69,590	69,590	69,590	69,590	69,590	69,590	69,590	69,590	69,590	69,590	69,590
LATS Allowance (BMW)	68,924	64,252	53,580	45,909	43,939	41,970	40,001	38,031	36,062	34,093	32,124

Year

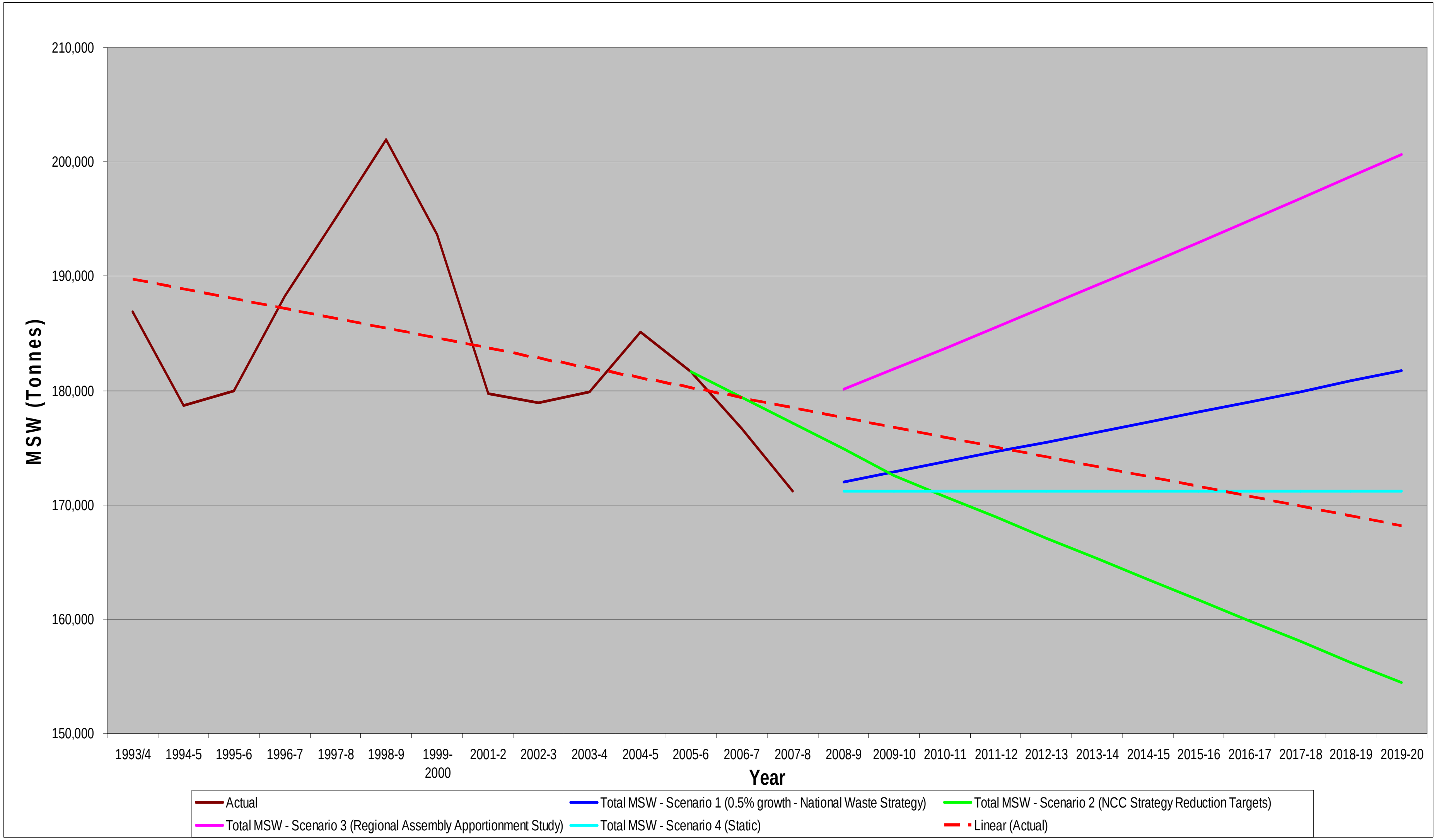
Appendix 3
Waste Disposal Comparison with Other Core Cities

Authority	Landfill	Incineration	Recycled/ composted	Other	Total	%Landfilled
Sheffield	40,032	130,038	74,345	-	244,415	**16.38%**
Nottingham	32,046	84,170	55,946	17	172,179	**18.61%**
Birmingham	108,768	325,167	139,613	-	573,548	**18.96%**
Manchester (Greater Manchester JWDA)*	788,827	88,855	410,139	640	1,288,461	**61.22%**
Bristol	115,589	5	69,908	0	185,502	**62.31%**
Liverpool(Merseyside JWDA)*	566,722	300	262,511	-	829,532	**68.32%**
Leeds	249,709	1,206	105,047	14	355,976	**70.15%**
Newcastle	122,946	-	44,417	3,771	171,135	**71.84%**

* JWDA - Joint Waste Disposal Authority which includes other districts

Appendix 4

Actual Municipal Solid Waste Production and Future Projection 1993/4 – 20019/20



Appendix 5
LATS Evaluation - 10,000 tonnes of residual waste treatment from 2009/10

Scenario 1 - National Waste Strategy

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		71,033	72,805	77,045	no	no	no
Base	Improvement		78,226	62,420	57,898	no	no	no
EfW	Static	10,000	71,033	66,005	70,245	no	no	no
EfW	Improvement	10,000	69,875	54,761	50,412	no	no	no
Gasification	Static	10,000	71,033	66,005	70,245	no	no	no
Gasification	Improvement	10,000	69,875	54,761	50,412	no	no	no
RDF	Static	10,000	71,033	66,005	70,245	no	no	no
RDF	Improvement	10,000	69,875	54,761	50,412	no	no	no
Autoclave	Static	10,000	71,033	67,305	71,545	no	no	no
Autoclave	Improvement	10,000	69,875	56,061	51,712	no	no	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 2 - NCC Targets

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		70,815	67,109	58,463	no	no	no
Base	Improvement		77,644	58,553	41,167	no	no	no
EfW	Static	10,000	70,815	60,309	51,663	no	no	no
EfW	Improvement	10,000	69,657	49,066	31,831	no	yes	no
Gasification	Static	10,000	70,815	60,309	51,663	no	no	no
Gasification	Improvement	10,000	69,657	49,066	31,831	no	yes	no
RDF	Static	10,000	70,815	60,309	51,663	no	no	no
RDF	Improvement	10,000	69,657	49,066	31,831	no	yes	no
Autoclave	Static	10,000	70,815	61,609	52,963	no	no	no
Autoclave	Improvement	10,000	69,657	50,366	33,131	no	no	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 3 - RSS Apportionment

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		77,170	80,868	89,939	no	no	no
Base	Improvement		83,740	69,832	70,072	no	no	no
EfW	Static	10,000	77,170	74,068	83,139	no	no	no
EfW	Improvement	10,000	76,013	62,825	63,306	no	no	no
Gasification	Static	10,000	77,170	74,068	83,139	no	no	no
Gasification	Improvement	10,000	76,013	62,825	63,306	no	no	no
RDF	Static	10,000	77,170	74,068	83,139	no	no	no
RDF	Improvement	10,000	76,013	62,825	63,306	no	no	no
Autoclave	Static	10,000	77,170	75,368	84,439	no	no	no
Autoclave	Improvement	10,000	76,013	64,125	64,606	no	no	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 4 - Static

CONTROL VERSION 4 – 7th January 2009

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		69,866	69,866	69,866	no	no	no
Base	Improvement		77,644	60,075	51,335	no	no	no
EfW	Static	10,000	69,866	63,066	63,066	no	no	no
EfW	Improvement	10,000	68,708	51,822	43,233	no	no	no
Gasification	Static	10,000	69,866	63,066	63,066	no	no	no
Gasification	Improvement	10,000	68,708	51,822	43,233	no	no	no
RDF	Static	10,000	69,866	63,066	63,066	no	no	no
RDF	Improvement	10,000	68,708	51,822	43,233	no	no	no
Autoclave	Static	10,000	69,866	64,366	64,366	no	no	no
Autoclave	Improvement	10,000	68,708	53,122	44,533	no	no	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Appendix 6
LATS Evaluation - 40,000 tonnes of residual waste treatment starting in 2012/13

Scenario 1 - National Waste Strategy

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		71,033	72,805	77,045	no	no	no
Base	Improvement		78,226	62,420	57,898	no	no	no
EfW	Static	40,000	71,033	45,605	49,845	yes	no	no
EfW	Improvement	40,000	69,875	34,361	30,012	yes	yes	no
Gasification	Static	40,000	71,033	45,605	49,845	yes	no	no
Gasification	Improvement	40,000	69,875	34,361	30,012	yes	yes	no
RDF	Static	40,000	71,033	45,605	49,845	yes	no	no
RDF	Improvement	40,000	69,875	34,361	30,012	yes	yes	no
Autoclave	Static	40,000	71,033	50,805	55,045	no	no	no
Autoclave	Improvement	40,000	69,875	39,561	35,212	yes	no	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 2 - NCC Targets

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		70,815	67,109	58,463	no	no	no
Base	Improvement		77,644	58,553	41,167	no	no	no
EfW	Static	40,000	70,815	39,909	31,263	yes	yes	no
EfW	Improvement	40,000	69,657	28,666	11,431	yes	yes	no
Gasification	Static	40,000	70,815	39,909	31,263	yes	yes	no
Gasification	Improvement	40,000	69,657	28,666	11,431	yes	yes	no
RDF	Static	40,000	70,815	39,909	31,263	yes	yes	no
RDF	Improvement	40,000	69,657	28,666	11,431	yes	yes	no
Autoclave	Static	40,000	70,815	45,109	36,463	yes	no	no
Autoclave	Improvement	40,000	69,657	33,866	16,631	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 3 - RSS Apportionment

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		77,170	80,868	89,939	no	no	no
Base	Improvement		83,740	69,832	70,072	no	no	no
EfW	Static	40,000	77,170	53,668	62,739	no	no	no
EfW	Improvement	40,000	76,013	42,425	42,906	yes	no	no
Gasification	Static	40,000	77,170	53,668	62,739	no	no	no
Gasification	Improvement	40,000	76,013	42,425	42,906	yes	no	no
RDF	Static	40,000	77,170	53,668	62,739	no	no	no
RDF	Improvement	40,000	76,013	42,425	42,906	yes	no	no
Autoclave	Static	40,000	77,170	58,868	67,939	no	no	no
Autoclave	Improvement	40,000	76,013	47,625	48,106	no	no	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 4 - Static

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		69,866	69,866	69,866	no	no	no
Base	Improvement		77,644	60,075	51,335	no	no	no
EfW	Static	40,000	69,866	42,666	42,666	yes	no	no
EfW	Improvement	40,000	68,708	31,422	22,833	yes	yes	no
Gasification	Static	40,000	69,866	42,666	42,666	yes	no	no
Gasification	Improvement	40,000	68,708	31,422	22,833	yes	yes	no
RDF	Static	40,000	69,866	42,666	42,666	yes	no	no
RDF	Improvement	40,000	68,708	31,422	22,833	yes	yes	no
Autoclave	Static	40,000	69,866	47,866	47,866	no	no	no
Autoclave	Improvement	40,000	68,708	36,622	28,033	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Appendix 7
LATS Evaluation - 40,000 tonnes of additional waste treatment starting in 2012/13 and then a further 40,000 tonnes becoming available in 2017/18

Scenario 1 - National Waste Strategy

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		71,033	72,805	77,045	no	no	no
Base	Improvement		78,226	62,420	57,898	no	no	no
EfW	Static	80,000	71,033	18,405	22,645	yes	yes	no
EfW	Improvement	80,000	69,875	7,161	2,812	yes	yes	no
Gasification	Static	80,000	71,033	18,405	22,645	yes	yes	no
Gasification	Improvement	80,000	69,875	7,161	2,812	yes	yes	no
RDF	Static	80,000	71,033	18,405	22,645	yes	yes	no
RDF	Improvement	80,000	69,875	7,161	2,812	yes	yes	no
Autoclave	Static	80,000	71,033	28,805	33,045	yes	no	no
Autoclave	Improvement	80,000	69,875	17,561	13,212	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 2 - NCC Targets

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		70,815	67,109	58,463	no	no	no
Base	Improvement		77,644	58,553	41,167	no	no	no
EfW	Static	80,000	70,815	12,709	4,063	yes	yes	no
EfW	Improvement	80,000	69,657	1,466	-15,769	yes	yes	yes
Gasification	Static	80,000	70,815	12,709	4,063	yes	yes	no
Gasification	Improvement	80,000	69,657	1,466	-15,769	yes	yes	yes
RDF	Static	80,000	70,815	12,709	4,063	yes	yes	no
RDF	Improvement	80,000	69,657	1,466	-15,769	yes	yes	yes
Autoclave	Static	80,000	70,815	23,109	14,463	yes	yes	no
Autoclave	Improvement	80,000	69,657	11,866	-5,369	yes	yes	yes
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 3 - RSS Apportionment

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		77,170	80,868	89,939	no	no	no
Base	Improvement		83,740	69,832	70,072	no	no	no
EfW	Static	80,000	77,170	26,468	35,539	yes	no	no
EfW	Improvement	80,000	76,013	15,225	15,706	yes	yes	no
Gasification	Static	80,000	77,170	26,468	35,539	yes	no	no
Gasification	Improvement	80,000	76,013	15,225	15,706	yes	yes	no
RDF	Static	80,000	77,170	26,468	35,539	yes	no	no
RDF	Improvement	80,000	76,013	15,225	15,706	yes	yes	no
Autoclave	Static	80,000	77,170	36,868	45,939	yes	no	no
Autoclave	Improvement	80,000	76,013	25,625	26,106	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 4 - Static

CONTROL VERSION 4 – 7th January 2009

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		69,866	69,866	69,866	no	no	no
Base	Improvement		77,644	60,075	51,335	no	no	no
EfW	Static	80,000	69,866	15,466	15,466	yes	yes	no
EfW	Improvement	80,000	68,708	4,222	-4,367	yes	yes	yes
Gasification	Static	80,000	69,866	15,466	15,466	yes	yes	no
Gasification	Improvement	80,000	68,708	4,222	-4,367	yes	yes	yes
RDF	Static	80,000	69,866	15,466	15,466	yes	yes	no
RDF	Improvement	80,000	68,708	4,222	-4,367	yes	yes	yes
Autoclave	Static	80,000	69,866	25,866	25,866	yes	yes	no
Autoclave	Improvement	80,000	68,708	14,622	6,033	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Appendix 8
LATS Evaluation - 50,000 tonnes of residual waste treatment starting in 2012/13

Scenario 1 - National Waste Strategy

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		71,033	72,805	77,045	no	no	no
Base	Improvement		78,226	62,420	57,898	no	no	no
EfW	Static	50,000	71,033	38,805	43,045	yes	no	no
EfW	Improvement	50,000	69,875	27,561	23,212	yes	yes	no
Gasification	Static	50,000	71,033	38,805	43,045	yes	no	no
Gasification	Improvement	50,000	69,875	27,561	23,212	yes	yes	no
RDF	Static	50,000	71,033	38,805	43,045	yes	no	no
RDF	Improvement	50,000	69,875	27,561	23,212	yes	yes	no
Autoclave	Static	50,000	71,033	45,305	49,545	yes	no	no
Autoclave	Improvement	50,000	69,875	34,061	29,712	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 2 - NCC Targets

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		70,815	67,109	58,463	no	no	no
Base	Improvement		77,644	58,553	41,167	no	no	no
EfW	Static	50,000	70,815	33,109	24,463	yes	yes	no
EfW	Improvement	50,000	69,657	21,866	4,631	yes	yes	no
Gasification	Static	50,000	70,815	33,109	24,463	yes	yes	no
Gasification	Improvement	50,000	69,657	21,866	4,631	yes	yes	no
RDF	Static	50,000	70,815	33,109	24,463	yes	yes	no
RDF	Improvement	50,000	69,657	21,866	4,631	yes	yes	no
Autoclave	Static	50,000	70,815	39,609	30,963	yes	yes	no
Autoclave	Improvement	50,000	69,657	28,366	11,131	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 3 - RSS Apportionment

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		77,170	80,868	89,939	no	no	no
Base	Improvement		83,740	69,832	70,072	no	no	no
EfW	Static	50,000	77,170	46,868	55,939	no	no	no
EfW	Improvement	50,000	76,013	35,625	36,106	yes	no	no
Gasification	Static	50,000	77,170	46,868	55,939	no	no	no
Gasification	Improvement	50,000	76,013	35,625	36,106	yes	no	no
RDF	Static	50,000	77,170	46,868	55,939	no	no	no
RDF	Improvement	50,000	76,013	35,625	36,106	yes	no	no
Autoclave	Static	50,000	77,170	53,368	62,439	no	no	no
Autoclave	Improvement	50,000	76,013	42,125	42,606	yes	no	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 4 - Static

CONTROL VERSION 4 – 7th January 2009

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		69,866	69,866	69,866	no	no	no
Base	Improvement		77,644	60,075	51,335	no	no	no
EfW	Static	50,000	69,866	35,866	35,866	yes	no	no
EfW	Improvement	50,000	68,708	24,622	16,033	yes	yes	no
Gasification	Static	50,000	69,866	35,866	35,866	yes	no	no
Gasification	Improvement	50,000	68,708	24,622	16,033	yes	yes	no
RDF	Static	50,000	69,866	35,866	35,866	yes	no	no
RDF	Improvement	50,000	68,708	24,622	16,033	yes	yes	no
Autoclave	Static	50,000	69,866	42,366	42,366	yes	no	no
Autoclave	Improvement	50,000	68,708	31,122	22,533	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Appendix 9
LATS Evaluation- 10,000 tonnes of additional residual waste treatment starting in 2009/10 and then a further 70,000 starting 2013/14

Scenario 1 - National Waste Strategy

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		71,033	72,805	77,045	no	no	no
Base	Improvement		78,226	62,420	57,898	no	no	no
EfW	Static	80,000	71,033	18,405	22,645	yes	yes	no
EfW	Improvement	80,000	69,875	7,161	2,812	yes	yes	no
Gasification	Static	80,000	71,033	18,405	22,645	yes	yes	no
Gasification	Improvement	80,000	69,875	7,161	2,812	yes	yes	no
RDF	Static	80,000	71,033	18,405	22,645	yes	yes	no
RDF	Improvement	80,000	69,875	7,161	2,812	yes	yes	no
Autoclave	Static	80,000	71,033	28,805	33,045	yes	no	no
Autoclave	Improvement	80,000	69,875	17,561	13,212	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 2 - NCC Targets

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		70,815	67,109	58,463	no	no	no
Base	Improvement		77,644	58,553	41,167	no	no	no
EfW	Static	80,000	70,815	12,709	4,063	yes	yes	no
EfW	Improvement	80,000	69,657	1,466	-15,769	yes	yes	yes
Gasification	Static	80,000	70,815	12,709	4,063	yes	yes	no
Gasification	Improvement	80,000	69,657	1,466	-15,769	yes	yes	yes
RDF	Static	80,000	70,815	12,709	4,063	yes	yes	no
RDF	Improvement	80,000	69,657	1,466	-15,769	yes	yes	yes
Autoclave	Static	80,000	70,815	23,109	14,463	yes	yes	no
Autoclave	Improvement	80,000	69,657	11,866	-5,369	yes	yes	yes
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 3 - RSS Apportionment

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		77,170	80,868	89,939	no	no	no
Base	Improvement		83,740	69,832	70,072	no	no	no
EfW	Static	80,000	77,170	26,468	35,539	yes	no	no
EfW	Improvement	80,000	76,013	15,225	15,706	yes	yes	no
Gasification	Static	80,000	77,170	26,468	35,539	yes	no	no
Gasification	Improvement	80,000	76,013	15,225	15,706	yes	yes	no
RDF	Static	80,000	77,170	26,468	35,539	yes	no	no
RDF	Improvement	80,000	76,013	15,225	15,706	yes	yes	no
Autoclave	Static	80,000	77,170	36,868	45,939	yes	no	no
Autoclave	Improvement	80,000	76,013	25,625	26,106	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Scenario 4 - Static

CONTROL VERSION 4 – 7th January 2009

Technology	Recycling	Scale T/pa	2009-10	2012-13	2019-20	2012/13 Target	2019/20 Target	Over provision
Base	Static		69,866	69,866	69,866	no	no	no
Base	Improvement		77,644	60,075	51,335	no	no	no
EfW	Static	80,000	69,866	15,466	15,466	yes	yes	no
EfW	Improvement	80,000	68,708	4,222	-4,367	yes	yes	yes
Gasification	Static	80,000	69,866	15,466	15,466	yes	yes	no
Gasification	Improvement	80,000	68,708	4,222	-4,367	yes	yes	yes
RDF	Static	80,000	69,866	15,466	15,466	yes	yes	no
RDF	Improvement	80,000	68,708	4,222	-4,367	yes	yes	yes
Autoclave	Static	80,000	69,866	25,866	25,866	yes	yes	no
Autoclave	Improvement	80,000	68,708	14,622	6,033	yes	yes	no
LATS Allowance			**68,924**	**45,909**	**32,124**			

Appendix 10 a
Waste Treatment Technology Datasheet – Advanced Thermal Treatment

Example - Energos ASA/Ener.G plc, Stavanger, Norway (Gasification)

Brief Process description

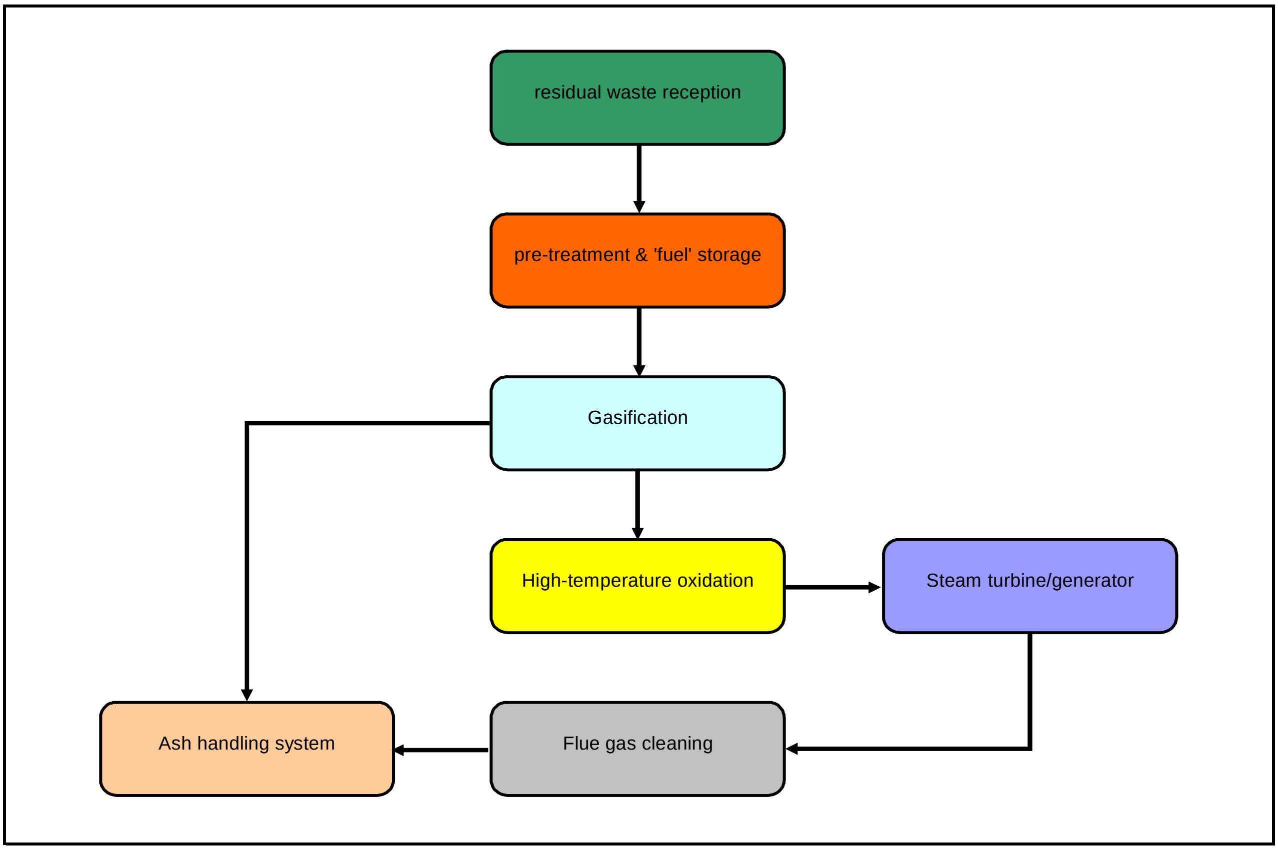
After being received at the plant, residual waste is converted into a refuse derived fuel via a shredding operation and the removal of metals. The refuse derived fuel is then stored in a bunker for loading into the gasification unit as required.

The main treatment process consists of a linked gasification and combustion unit. The process is divided into a primary chamber, where the gasification of the fuel takes place, and a secondary gas combustion chamber. The primary chamber is fed with the waste derived fuel and primary air. The resulting slag is discharged from the end of the grate and cooled in a water-basin.

The combustible gases (often called 'syngas') resulting from the primary chamber are combined with secondary air and re-circulated flue gas to obtain the desired combustion profile in the secondary gas combustion chamber. Steam raising plant produces steam for use in industrial processes, district heating systems and/or for electricity production via a steam turbine/generator set.

Re-circulated flue gas is used to help control the combustion process, resulting in lower oxides of nitrogen formation and thereby reducing the footprint of the flue gas cleaning equipment. Flue gas cleaning comprises the addition of lime and activated carbon, followed by a bag filter to clean the exhaust gas prior to release to atmosphere. Other than the 2 stage gasification and combustion process the plant works in much the same way as a conventional energy from waste incinerator.

Forus gasification plant process schematic



Appendix 10 b
Waste Treatment Technology Datasheet – Anaerobic Digestion
Example - Biocycle South Shropshire Ltd

Brief process description

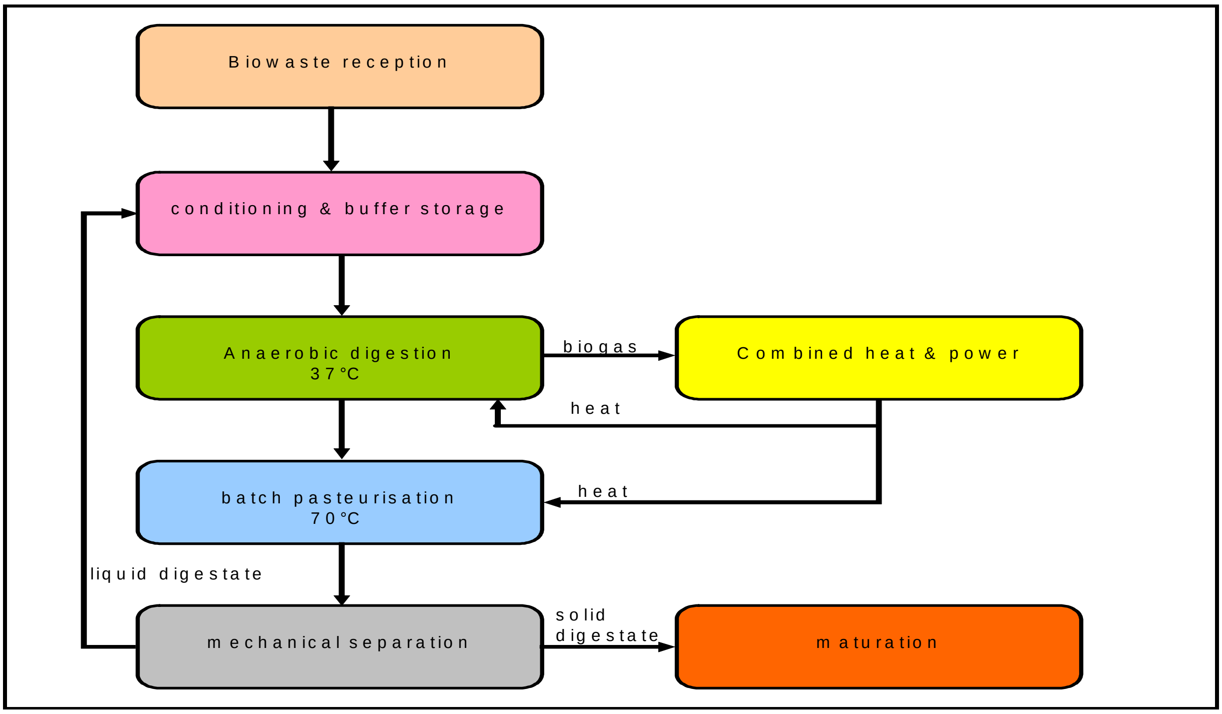
The bio-waste is delivered by RCV and tipped into a reception hall. A bucket-loader charges the shredder. After shredding, the waste is blended with digestate in a conditioning tank, where a second shredding operation takes place. Reception hall process air is passed through a bio-filter.

Conditioned bio-waste is fed to the anaerobic digester where microbes breakdown the waste in the absence of air, producing biogas and a digestate. Batch pasteurisation raises ensures total pathogen kill. Digestate is retained in storage tank, designed to allow for one month's storage, prior to delivery to farms.

In the digestate hall, the mechanical separation of the digestate into a solid and a liquid fraction takes place. A press forces the liquid through a 1mm screen. The liquid digestate is pumped to the conditioning tank in the reception hall in order to 'seed' raw bio-waste. Surplus liquid digestate is used as a bio-fertiliser in local agriculture. Solid digestate, which is similar to compost, is stored in the digestate hall where it is allowed to mature in heaps before being used in local agriculture as a soil conditioner.

The biogas is utilised in a combined heat and power unit. The CHP unit comprises a spark-ignition gas engine driving an electricity generator. Some of the electricity produced is used to power the AD plant and the surplus is exported to the national grid and sold as 'green electricity'. Some of the heat is used to raise the temperature of the digester and the pasteurisation unit, as well as heating the building in the winter. It is understood that there are future plans for a district heating system to export heat to adjacent industrial units.

Biocycle AD process schematic



Appendix 10 c
Waste Treatment Technology Datasheet – Autoclave
Example – Estech Europe Limited Aldridge, West Midlands

Brief process description

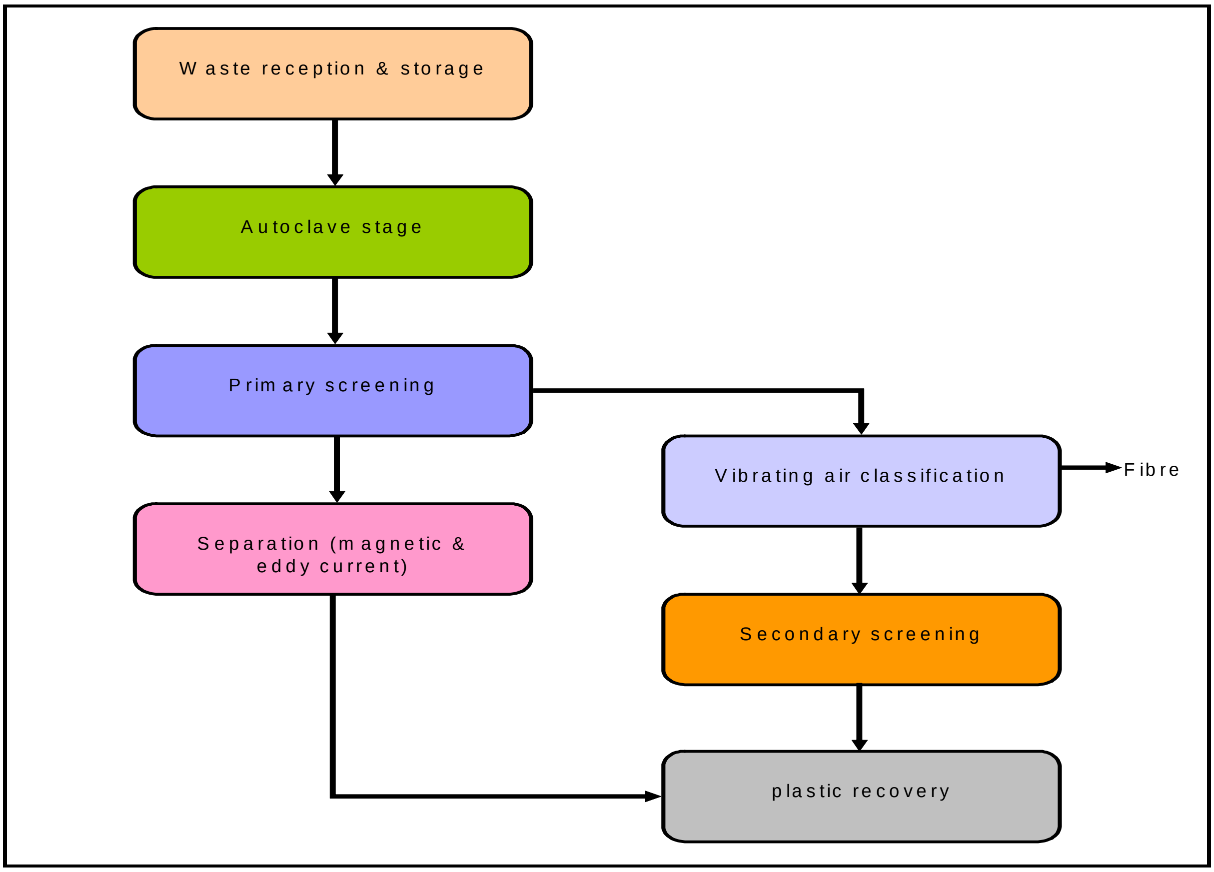
The autoclave stage is central to the plant which operates in a batch processing mode. After charging with waste the rotating autoclave drum is sealed. Saturated steam is injected into the rotating autoclave drum. The pressure in the vessel is maintained at 5 bar gauge for a period of up to 45 minutes to allow the process to fully ‘cook’ the waste, breaking it down into its organic and inorganic constituents.

The autoclave process is designed to ensure complete pathogen and virus kill, and results in a substantial volume reduction. Processed waste is then treated by state of the art mechanical separation plant and equipment (e.g. over-band magnet, eddy current separator and air classifier) to separate recyclate from the homogenous ‘fibre’ and the residue for management in landfill. The heat, steam and rotating action of the autoclave vessel strip of labels and glues from food cans; this leaves a high quality ferrous/non-ferrous metals stream for recycling; plastics are also deformed as a result of the process increasing their bulk density.

The resulting fibre comprises the putrescible, cellulose and lignin elements of the waste stream. A number of possible uses exist:

- Solid Recovered Fuel (SRF);
- as a feedstock to anaerobic digestion; and
- as a raw material in the production of paper and construction materials

Autoclave process schematic



Appendix 10 d
Waste Treatment Technology Datasheet – Incineration
Example Chineham Energy Recovery Facility

Brief process description

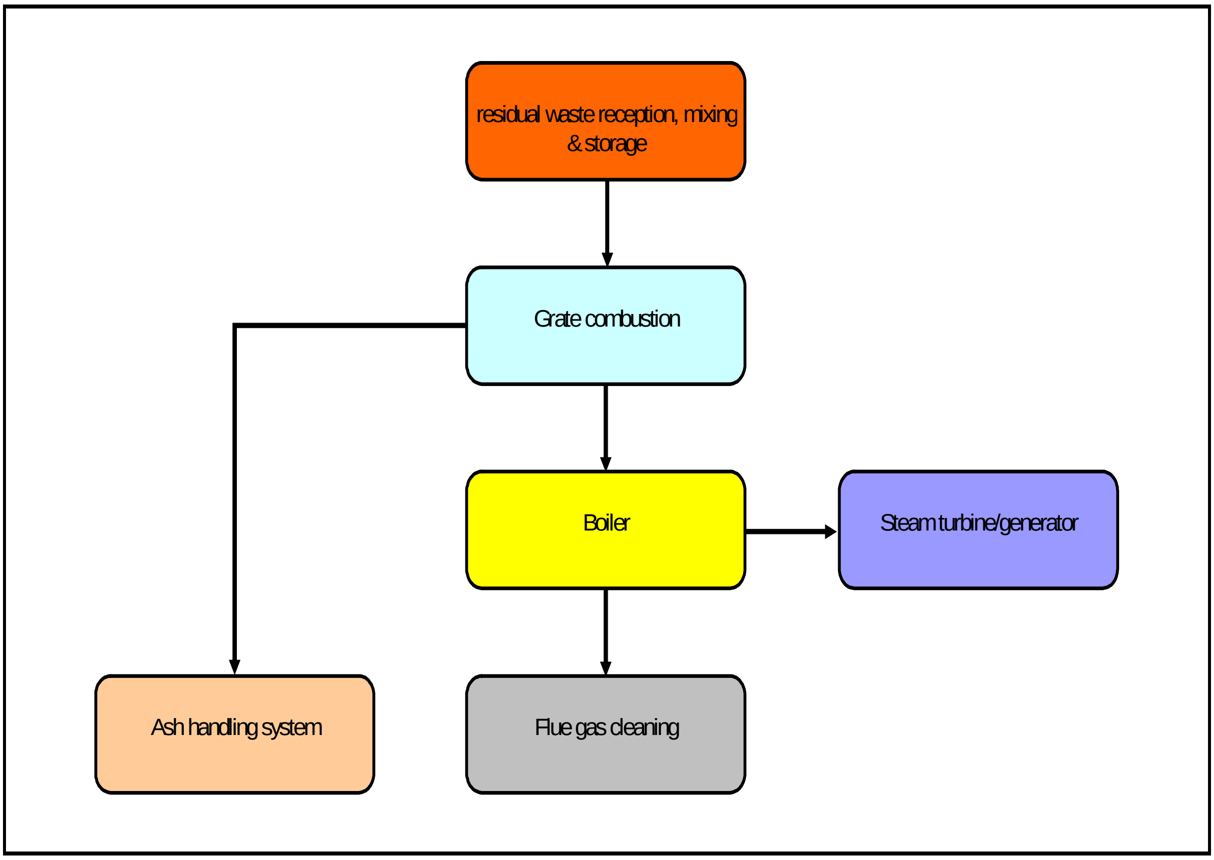
Residual household waste which is recycled is sent to the Chineham Energy Recovery Facility where it is tipped into a bunker. A crane grabs the waste and places it into the feed hopper. The waste then drops down a feed chute under gravity onto the grate. The action of the grate turns the waste to allow it to burn fully.

The burnt-out 'bottom ash' passes through the ash discharger onto an ash handling system, which uses a magnetic separator to extracts metal for recycling. The remaining bottom ash is sent for recycling or managed in landfill.

Hot gases produced in the combustion process pass through a boiler where they heat the water converting it into steam. A turbo-generator uses the steam to produce electricity for export to the National Grid.

The gases from the boiler go through an extensive flue gas cleaning process which starts with the gas scrubber where lime is injected to neutralise acid gases. Activated carbon is added to remove dioxins, urea is added to treat oxides of nitrogen and finally a bag filter removes remaining particulates. The resulting material known as Air Pollution Control residue is sent to the Midlands where it is used to neutralise acidic wastes before being sent to a non-hazardous landfill site. The cleaned gases are finally released into the atmosphere through the chimney.

Chineham energy recovery process schematic



Appendix 10 e
Waste Treatment Technology Datasheet – Mechanical Biological Treatment

Example – Shanks, Frog Island, East London

Brief process description

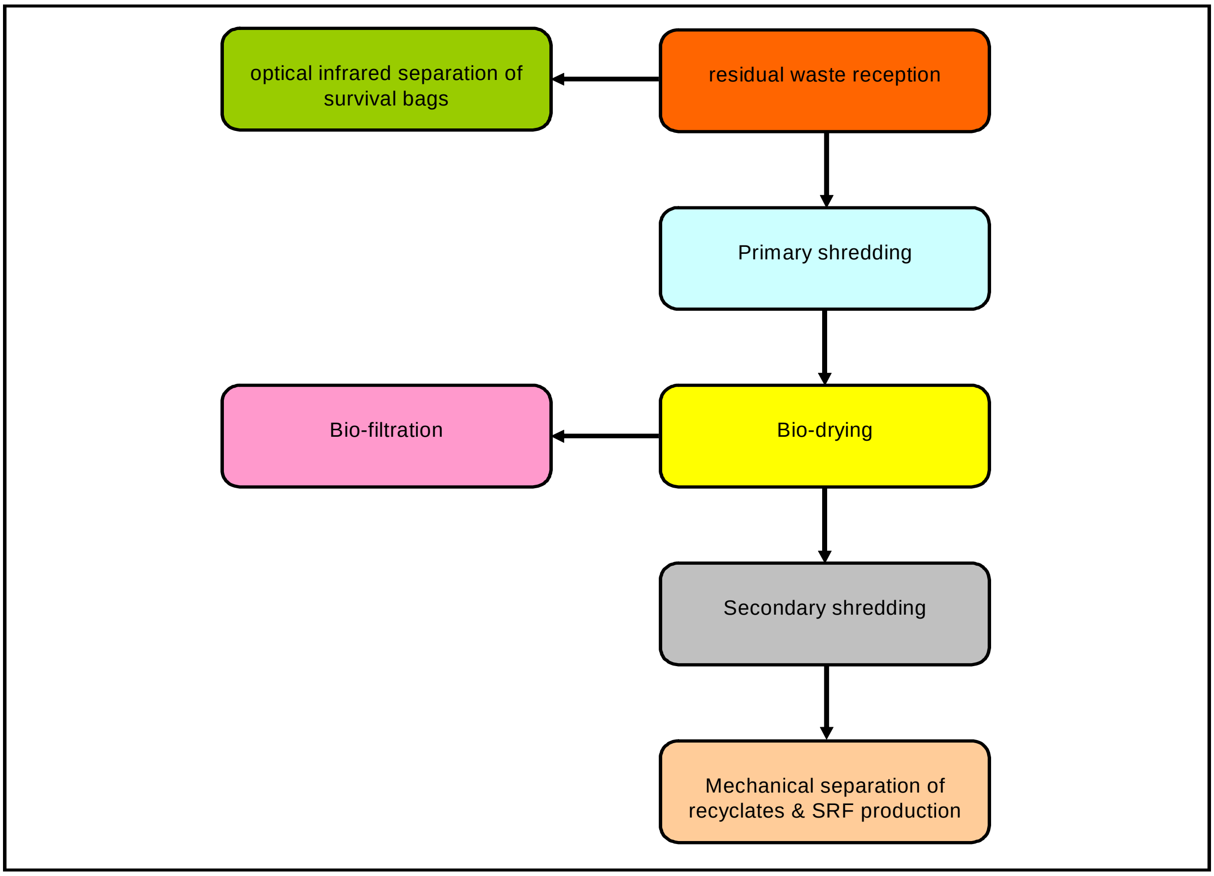
Bagged residual household waste is tipped into a reception pit and a crane transfers the bags onto a conveyor. In the optical separation room, orange survival bags containing dry recyclate are identified from the other rubbish bags by an infrared sensor, and removed by a mechanical paddle for treatment in a Materials Recycling Facility (or MRF).

The remaining waste is then shredded and dried in tunnels over a 14 day period, using the heat from aerobic microbes as they breakdown the waste. The bio-drying floor is a raised, perforated surface through which air is circulated to maximise waste decomposition.

The bio-dried waste then undergoes a secondary shredding stage after which the remaining recyclable materials, such as glass or stone, are extracted using mechanical sorting plant and equipment. Around 10% of the separated waste throughput represents a compostable fraction which is currently landfilled.

The combustible material can be used as a Solid Recovered Fuel (SRF); a considerable amount of the energy is derived from the biomass content – as such the SRF is in part a renewable source of fuel. Shanks have recently signed a new long-term supply agreement with Castle Cement for up to 50,000 tonnes p.a. of SRF for its Ketton works, Rutland. A similar contract was signed in 2006 for supply of SRF to Castle's works at Padeswood, North Wales. Where markets do not exist for the SRF, the material can be landfilled with a considerably reduced potential to produce methane (a potent greenhouse gas) when compared to untreated residual waste. Extracted air is filtered before leaving the building to minimise release of odours, and automatic water sprays across the doorways prevent insects from leaving the building.

Frog Island MBT process schematic



Appendix 10 f
Waste Treatment Technology Datasheet – Use of Solid Recovered Fuel
Example – Ketton Cement works

A typical cement kiln uses raw materials (such as limestone and clay) and heats these to almost melting point (1,450℃). This ensuing chemic al reaction produces clinker which can then be ground with gypsum and other additives to produce cement. As a result of the high temperatures, the manufacture of cement is an extremely energy intensive process. Traditionally, the majority of this energy came from the use of fossil-fuels (e.g. coal).

Castle Cement produces over a quarter of the UK's total annual cement. Over the last decade the industry has trialed and/or used a number of fossil-fuel substitutes; more recently including SRF. Castle Cement recently signed a long-term SRF agreement with Shanks for the supply of up to 50,000 tonnes p.a. from the Ecodeco technology at Frog Island - to the Ketton works. A similar contract was signed in 2006 for supply of SRF to Castle's works at Padeswood, North Wales.

Displacing fossil-fuel with SRF, where a considerable portion of the energy results from biogenic carbon (i.e. non-fossil carbon), is resulting in increased performance of the UK cement industry, where global warming gases are concerned. Castle Cement now claims to be the UK's lowest emitter of CO2 per tonne of cement produced. However, this isn't just about altruism; at present Castle Cement is paid a gate fee to take the SRF and given that energy is a significant cost centre in cement manufacture, the economic benefits are considerable.

Appendix 11 --Waste Study Tour Itinerary

UK-leg: Newcastle City Council: waste study tour[1]							
Visit	**Technology**	**Company**	**Technology supplier**	**Waste feedstock**	**Facility name and Location**	**Scale**	**Outputs**
10th March a.m.	Energy from waste – incineration	Veolia Environmental Services	CNIM	Residual waste from North Hampshire districts	Integra North Energy Recovery Facility, Chineham, Hampshire	90,000 tonnes p.a.	- Electricity (up to 8MW) - bottom ash to aggregate uses, or landfilled - APC residues landfilled
10th March p.m.	Mechanical-Biological Treatment (MBT)	ELWA Ltd Waste Disposal Contractor: Shanks	Sistema Ecodeo, Italy	Residual waste from 4 East London Boroughs	Frog Island, Rainham, East London	180,000 tonnes p.a.	- Solid Recovered Fuel - recyclate - landfill
11th March a.m.	Autoclave	Estech Europe Ltd	Estech Europe Ltd	Batched MSW sourced appropriate to demonstrator location	Aldridge, West Midlands	5,000 tonnes p.a. mobile demonstration plant	- recyclate - fibre: possible end-uses as SRF, AD feedstock, or paper/construction industries
11th March p.m.	Anaerobic digestion	Biocycle South Shropshire Ltd	Greenfinch Ltd	Source segregated kitchen waste and green waste[2]	Ludlow, Shropshire	5,000 tonnes p.a. Defra NTDP demonstrator plant	- green electricity - liquid bio- fertiliser - solid digestate
Norwegian-leg: Newcastle City Council: waste study tour							
31st March p.m.	Energos	Lyse Energi 67% and IVAR IKS 33%	Energos AS – part of Ener.G plc	MSW	Forus	38,000 tonnes p.a.	• steam • electricity

[1] A planned visit to Castle Cement's Ketton works on 11th March to see how SRF (arising from Frog Island MBT plant) was being utilised in cement manufacture was unfortunately cancelled due to circumstances outside the control of both AiIE Ltd and Newcastle CC.

[2] For the purposes of the demonstration plant, kitchen waste is sourced from Somerset due to logistical issues with collection within South Shropshire. On a commercial plant, the facility and feedstock would be located much nearer to one another.

Appendix 12 – An Explanation of WRATE Methodology

Environmental Impact Categories
By assess environmental impacts by looking at appropriate *environmental impact categories*.

WRATE uses 6 impact categories

- **Abiotic Resource depletion** - This impact category indicator is related to extraction of scarce minerals and fossil fuels. The scale of the impact is based on the remaining reserves and rate of extraction.
- **Freshwater aquatic ecotoxicity** - The emission of some substances can have impacts on ecosystems. This category measures the exposure and effects of substances released on the freshwater environment eg. rivers and lakes.
- **Acidification** - Acidic gases such as sulphur dioxide (SO2) react with water in the atmosphere to form "acid rain", which can cause environmental damage.
- **Eutrophication** – some substances like nitrates and phosphates can encourage excessive growth of algae, reducing the oxygen within the water and damaging ecosystems.
- **Global warming** - is caused by the release of "greenhouse gases" such as carbon dioxide (CO2).
- **Human toxicity**- The emission of some substances can have impacts on human health.

Characterisation
Characterisation measures the level of environmental impact caused by each scenario studied in WRATE. Characterised results are calculated for each impact category with findings presented in appropriate units (i.e. through use of a reference substance such as kg CO2 equivalents for global warming).

Impacts in one category can be caused by many different substances, and one substance can contribute to several impact categories. Characterisation is where all the different substances contributing to each impact category are assessed relative to one another to give an overall measure of the level of impact in each category.

The contribution of each substance to the impact category is calculated by converting the amount of substance into the equivalent amount of the reference substance or unit. This conversion is done using *characterisation factors*. For example, for global warming, the reference substance is CO2. So, the effects of 1 tonne of methane are converted into the amount of CO2 needed to cause the same effect over a 100-year timescale - as methane is 23 times more damaging than CO2; the climate change characterisation factor for methane is 23.

Normalistion
"Normalistion" allows a direct comparison of the relative magnitude of different environmental impacts by conversion to a common unit. It involves taking the characterised outputs from the impact categories and converting them to a single standard unit. RATE uses a "standard European person" as this common unit ie. The number of average people that would cause the same impact over the course of a year.

Appendix 13- Headline WRATE Results

Results					
	Baseline	**Incineration**	**Gasification**	**SRF**	**Autoclaving**
Abiotic Resource Depletion	493	-2988	-1846	-10308	-530
Global Warming	190	498	91	-202	166
Human Toxicity	67	95	68	77	116
Freshwater aquatic ecotoxicty	179	-21	160	164	167
Acidification	139	623	228	-769	316
Eutrophication	43	233	75	236	168
Total	**1111**	**-1560**	**-1224**	**-10802**	**403**
Difference to Baseline (net impact)					
		Incineration	**Gasification**	**SRF**	**Autoclaving**
Abiotic Resource Depletion		-3481	-2339	-10801	-1023
Global Warming		308	-99	-392	-24
Human Toxicity		28	1	10	49
Freshwater aquatic ecotoxicty		-200	-19	-15	-12
Acidification		484	89	-908	177
Eutrophication		190	32	193	125
Total	**0**	**-2671**	**-2335**	**-11913**	**-708**

Best
Worst

Appendix 14
Literature review findings- synopsis of environmental consequences of waste management from DEFRA health effects report

Background

DEFRA (The Department for Environment, Food and Rural Affairs) commissioned Enviros Consulting Ltd and Birmingham University to draw together the available information on the environmental and health effects of managing municipal solid waste[3]. The study considers municipal solid waste and similar wastes. The report considers different waste management technologies for managing MSW: MBT, AD, gasification, incineration, landfill and waste transportation. Autoclave is not considered. The report includes an extensive search and review of the available literature relating to waste management activities.

DEFRA asked the Royal Society to look at the report in detail. This raised limitations, restricting report's usefulness in a policy making context. The limitations concern what is missing from the report and, in some places, the use made of the data reported (e.g. a lack of life-cycle thinking and a bias towards concentrating on the effects of air pollution, given the absence of good quality information where other environmental consequences are concerned).

The review's main finding is that whilst the information is incomplete and not ideal, the weight of evidence from the studies so far is that present-day practice for managing MSW has at most a minor effect on human health and the environment. This should be viewed in the light of the benefits of collection and disposal of the waste generated. If waste were not collected, treated and disposed, it would become a source of disease, odours, litters and pests.

Health and Environmental effects

A lot of detailed research has been carried out (e.g. landfill sites have been investigated as the possible cause of birth defects, cancers and respiratory illnesses including asthma) both at these specific sites and nationally, to investigate whether waste management operations do in fact have any adverse health effects. There is also concern about the environmental effects of facilities which manage MSW (e.g. odours or noise.) The authors' investigated whether there is scientific evidence for the occurrence of the environmental effects.

The possible health effects of waste management operations were investigated in 2 main ways:

- epidemiological studies – these are studies of the distribution (or pattern) and determinants (or causes) of disease in human populations.
- emissions based studies – which measure emissions being released into the environment from one or more sources.

Health and environmental issues in context

Waste management operations are only one of many sources of emissions and health/environmental effects. The study therefore also looked at other sources of emissions such as road traffic, other industries, and domestic activities. This enabled the emissions from waste management facilities to be put into context with other sources of emissions, enabling their relative importance to be reported. Estimated health effects of waste management in the context of other issues which affect health were also

[3] from www.defra.gov.uk/environment/waste

considered, including the health effects of air pollution, passive smoking, road traffic accidents, and accidents in the home or at work.

Main emissions from municipal solid waste

The main emissions considered in the study and key findings are included below.

Emissions to air considered in the study	C	M	A	P	I	L	T
Carbon Dioxide	✓	✓			✓	✓	✓
Dioxins and Furans		✓		✓	✓	✓	✓
Hydrogen Chloride		✓	✓	✓	✓	✓	
Hydrogen Fluoride		✓	✓	✓	✓	✓	
Individual volatile organic compounds: benzene, chlorobenzene, chloroethane, chloroethene, 1,1-dichloroethane tetrachloroethene	✓		✓			✓	✓
Metals: arsenic, cadmium, mercury, nickel			✓	✓	✓	✓	
Methane	✓	✓	✓	✓	✓	✓	
Nitrogen Oxides		✓	✓	✓	✓	✓	✓
Particulate Matter	✓		✓	✓	✓	✓	✓
Polychlorinated Biphenyls					✓		
Sulphur Dioxide		✓	✓	✓	✓	✓	✓
Total Volatile Organic Compounds		✓		✓	✓	✓	✓

C: Composting; M: MBT; A: Anaerobic digestion; P: Gasification/pyrolysis; I: Incineration; L: Landfill; T: Transport

Substances in solid residues (reused or disposed of) considered in the study

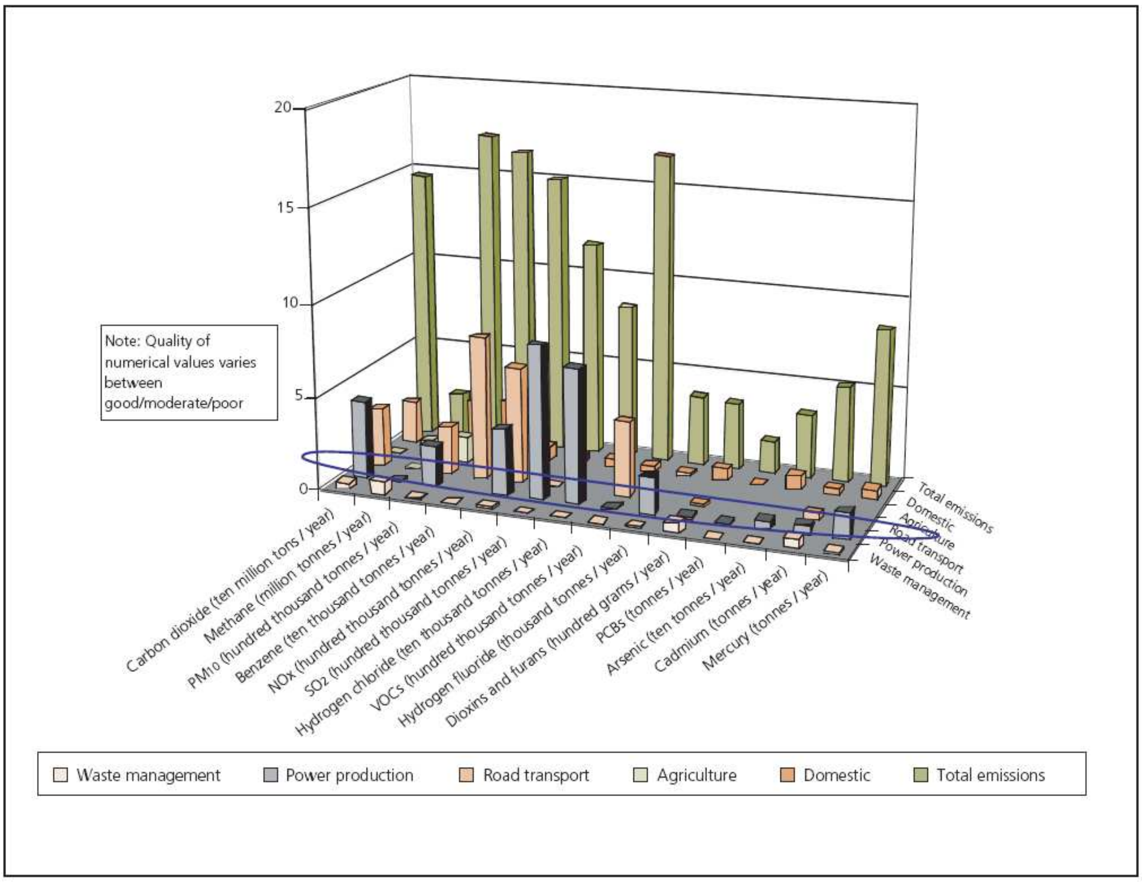
	C	M	A	P	I	L	T		C	M	A	P	I	L	T
Aluminium				✓	✓			Lead	✓		✓	✓	✓		
Ammonium	✓			✓				Magnesium	✓				✓		
Antimony					✓			Manganese					✓		
Arsenic	✓				✓			Mercury	✓		✓		✓		
Barium					✓			Nickel	✓		✓	✓	✓		
Cadmium	✓		✓	✓	✓			Phenol				✓			
Calcium					✓			Potassium					✓		
Carbonate					✓			Sodium					✓		
Chlorine				✓	✓			Sulphate				✓	✓		
Chromium	✓		✓	✓	✓			Sulphite					✓		
Cobalt					✓			Tin					✓		
Copper	✓		✓	✓	✓			Titanium					✓		
Dioxins and Furans	✓				✓			Vanadium					✓		
Fluoride					✓			Zinc	✓		✓	✓	✓		
Iron	✓				✓										

Emissions to sewer, groundwater or surface water considered in the study																
	C	M	A	P	I	L	T		C	M	A	P	I	L	T
Aniline						✓		Methyl chlorophenoxy acetic acid						✓	
Arsenic					✓	✓		Methyl tertiary butyl ether						✓	
Biphenyl						✓		Naphthalene						✓	
Cadmium	✓				✓	✓		Nickel					✓	✓	
Chloride	✓				✓	✓		Nitrogen		✓	✓			✓	
Chromium	✓				✓	✓		Nonyl phenol						✓	
Copper	✓				✓	✓		Organo-tin						✓	
Cyanide	✓					✓		Pentachlorophenol						✓	
Di (2-ethyl hexyl) phthalate						✓		Phenols	✓					✓	
Dichloromethane						✓		Phosphorus						✓	
Ethylbenzene						✓		Polycyclic aromatic hydrocarbons						✓	
Fluoride						✓		Suspended solids	✓					✓	
Lead	✓				✓	✓		Toluene						✓	
Mecoprop						✓		Xylene						✓	
Mercury	✓				✓	✓		Zinc	✓				✓	✓	

- MSW management accounts for a small proportion of most emissions in the UK: less than 2.5% of almost all emissions the authors were able to quantify (this information is mostly of good quality). The exceptions to this are emissions to air of methane (which accounted for nearly 30% of the UK total) and cadmium (10% of the national total). Almost all of the cadmium emitted to air from facilities dealing with MSW comes from landfill sites.
- Methane and carbon dioxide are the two emitted substances which may significantly influence global warming. Management of MSW accounted for 3.6 MT (2.4% of the national total). Other important contributors are electricity generation (28.5% of the national total); and transport (21% of the national total). These figures are of moderate or good quality.
- Methane has a global warming effect which is over 20 times more powerful than carbon dioxide. Emissions from MSW in landfill sites account for 0.7 MT (27% of the national total). These figures are of moderate or poor quality. Another important contributor is agriculture, which accounts for an estimated 1.0 MT (about 40% of the UK total).
- Benzene causes concern because it can cause cancer. The report found that less than 0.02% of UK emissions are due to MSW operations (this figure is of moderate quality). Transport is the main source of benzene, accounting for 47% of UK emissions.
- There are considerable public concerns surrounding dioxins and furans. UK expert committees regard dioxins as a probable human carcinogen (that is, it can probably cause cancer in humans). The review found that MSW management accounts for about 1% of UK emissions of dioxins, shared approximately equally between incineration and emissions from burning landfill gas. This figure is of poor quality because of uncertainty over dioxin emissions from other sources. Domestic sources such as cooking and burning coal for heating are the UK's single largest source of dioxins, accounting for about 18% of emissions. Transport accounts for about 3% and electricity generation about 4% of the UK total. A number of other sources

contribute to emissions of dioxins to a similar or greater extent: accidental vehicle fires; fireworks and bonfires; small-scale waste burning (for example on building sites); incineration of other wastes; and the iron and steel industry.

- Nitrogen dioxide is a substance of concern, particularly for air quality in urban areas. Emissions of oxides of nitrogen also contribute to acid rain, and excessive levels of nitrogen which can be harmful to some sensitive habitats. MSW management results in less than 1% of the UK total – the main contributors are electricity generation (24%) and road traffic (42%) (those values are of moderate quality).
- Metals emitted to the air have a range of possible health effects. MSW management results in about one tenth of UK emissions of cadmium (a substance associated with cancer of the lungs, throat and prostate, reproductive effects and kidney disease). Almost all of the cadmium emitted from facilities dealing with MSW comes from landfill sites.
- MSW management accounts for lower proportions of UK emissions of other substances. The iron and steel industry is the main source of emissions of most heavy metals (e.g. mercury and cadmium). The numerical values are of moderate or poor quality.



The main findings of the study

- Incineration produces the greatest emissions of oxides of nitrogen, followed by pyrolysis/gasification and landfill (information of moderate quality).
- Composting produces the highest emissions of particulates per tonne of municipal solid waste, although these data are of poor quality. Incineration is also an important source. Emissions from transport of waste are unlikely to be important.
- Sulphur dioxide emissions are similar for all processes which burn waste, or gases generated by decomposing waste (information of moderate quality). Transport of waste is unlikely to be important.
- Hydrogen chloride and hydrogen fluoride emissions are higher from processes where waste or waste gases are burnt, and incineration is the biggest source of hydrogen chloride (information of moderate quality).
- VOC emissions are likely to be greater from landfill, composting and MBT than from combustion processes. Methane emissions are highest from landfill (information of poor or moderate quality).
- Emissions of dioxins and furans per tonne of waste from incineration are higher than from other options, with other processes burning waste gases having lower emissions. Emissions from incineration in the UK have changed dramatically, with a 99.8% reduction in emissions since 1990. This was brought about following limits imposed in European Commission directives.
- Landfill is the only significant source of emissions to sewer, surface water and groundwater.
- Other than landfill, all of the processes result in other outputs. These may be useful products (e.g. compost or the digested material from an anaerobic digestion facility). Materials recycling facilities produce materials which are sent for reprocessing into useable products.

Environmental effects

The most important environmental impact reported in scientific research is the effect on global warming of emissions of greenhouse gases (most importantly, methane) from landfill of MSW. The below matrix summarises the other key environmental issues.

Summary of key environmental issues

Activity	Noise	Odour	Dust	Flora/ fauna	Soils	Water quality/ flow	Air quality	Climate	Building damage
Materials recycling facility	×	×	×	×	×	××	××	–	–
Composting	××	×××	××	✓	× ✓	××	×××	×	–
Mechanical biological treatment	××	×××	××	–	–	××	××	×	×
Anaerobic digestion	××	××	×	× ✓	× ✓	××	××	×	×
Gasification/ pyrolysis	××	××	××	–	–	–	××	×	×
Incineration with pre-sorting	××	××	×××	××	××	××	×××	×	×
Incineration	××	××	×××	×××	×××	×××	×××	×	×
Landfill	×××	×××	××	××× ✓	×××	×××	×××	××××	×
Waste transfer stations	××	×××	×	–	–	××	×	✓	–

Category	Meaning
✓	Direct or indirect benefit
–	No effect
×	Unlikely to be significant
××	Potentially significant impact in some cases, but can be controlled
×××	Impact can normally be controlled, but an issue at sites if design, engineering or operation falls below best practice
××××	An issue at all sites

Appendix 15
Dioxin comparisons across residual waste technologies

Background

The term "dioxin" is used to refer to the polychlorinated dibenzo-p-dioxins (PCDD) and "furan" is used for polychlorinated dibenzofurans (PCDF). There are 210 PCDD/F compounds in total. PCDDs and PCDFs are unintentionally formed and released from thermal processes involving organic matters and chlorine as a result of incomplete combustion or chemical reactions. Emissions arising from waste incineration and refuse-derived fuel production result from the PCB content of the waste[4].

Dioxins are also produced by natural processes, such as volcanic eruptions, forest fires and on bonfire night. As dioxins and furans have never been produced intentionally[5] on an industrial scale or for any commercial application, the production of PCDD/PCDF cannot be prohibited or phased out by legislation. However, industrial releases of dioxins are strictly controlled under pollution prevention and control regulations.

Concentration and toxic level of dioxins are reported in the units of TEF, I-TEF, TEQ, and I-TEQ. Of the seventeen PCDD and PCDF congeners with chlorine in the 2,3,7 and 8 positions, 2,3,7,8-TCDD is the most toxic, and by convention is assigned a toxicity rating of 1.0, called a Toxicity Equivalent Factor (TEF). The remaining 2,3,7,8-positional congeners are then assigned lower TEFs relative to the toxicity of 2,3,7,8-TCDD.

In 1988, the North Atlantic Treaty Organisation's Committee on the Challenges of Modern Society (NATO/CCMS) developed a toxicity rating system for dioxins under which the TEFs are termed International TEFs, or I-TEFs. All congeners other than the seventeen 2,3,7,8-positional congeners that may be present in a sample are assigned a TEF value of zero. The summation of individual TEQs for a mixture of PCDDs and PCDFs is termed the International Toxicity Equivalent or I-TEQ of the mixture.

Dioxins in context

According to Defra statistics[6] between 1990 and 2006 UK emissions of dioxins declined from 1,146 toxic equivalents to 197 toxic equivalents[7]. The 2004 Defra commissioned health effects review indicates that about 1% of UK dioxin releases resulted from waste management – roughly equally split between landfill and incineration. However, the report goes onto explain this figure is of poor quality because of uncertainty over dioxin emissions from other sources. Domestic sources such as cooking and burning coal for heating are the UK's single largest source of dioxins, accounting for about 18% of emissions. A number of other sources contribute to emissions of dioxins to a similar or greater extent: accidental vehicle fires; fireworks and bonfires; small-scale waste burning (for example on building sites); incineration of other wastes; and the iron and steel industry.

The 2006 NETCEN review[8] on source inventories for dioxin emissions indicates sources where emissions are greater than 0.05 g I-TEQ (total 323.24 g I-TEQ). This indicates

[4] Dore, C.J. et al, UK Emissions of Air Pollutants 1970 to 2001, AEA Technology Report, National Environmental Technology Centre, 2003
[5] UNEP Dioxin & Furan Inventories, National and Regional Emissions of PCDD/PCDF, Prepared by UNEP Chemicals, Geneva, Switzerland, May 1999
[6] www.defra.gov.uk/environment/statistics/airqual/download/xls/aqtb28.xls
[7] www.defra.gov.uk/environment/statistics/airqual/download/xls/aqtb28.xls
[8] A Review of the Current Source Inventories for Dioxin and Dioxin-like PCBs for Air, Soil, & Water with view to updating Emission Factors/Estimates and Inclusion of New Sources, Final Report, Netcen/ED48412/R1, April 2006

dioxins from municipal waste incineration made up less than 1% of the UK's total emissions for that year.

The Waste Incineration Directive sets the most stringent emissions controls for any thermal processes regulated in the EU. This sets minimum combustion conditions (850ºC for 2 seconds for non-hazardous waste) and limits the release to the atmosphere of the following specific emissions:

• sulphur dioxide (SO_2)

• nitrogen oxides (NO_x)

• hydrogen chloride (HCl)

• volatile organic compounds (VOC)

• carbon monoxide (CO)

• particulate (fly ash)

• heavy metals

• dioxins and furans

There is a requirement that the resulting bottom ash has a total organic carbon content of less than 3 per cent.

Health effects

The literature review did not identify any report which authoritively provided a comparison of dioxin releases across the full range of residual waste treatment technologies. The 2004 Defra commissioned report[9] into the health effects of waste management remains the most widely referenced document on the subject, but excludes consideration of autoclave and SRF use in cement kilns – any revision to this document would amongst other changes need to include these technologies to reflect current local authority and market interest.

The remainder of this section summarises the salient points arising from the 2004 Defra health effects report.

- Incinerators have been investigated as to possible increases in cancer, birth defects and respiratory illnesses including asthma. Other studies have particularly concentrated on emissions of dioxins. In the past most attention has been placed upon dioxin releases from municipal waste incinerators.
- The public are generally concerned about emissions of dioxins and furans. The developing reproductive system of male offspring seems to be particularly sensitive to exposure to dioxins before birth. Dioxins are associated with other developmental and reproductive effects, and the immune system is also potentially sensitive. UK expert committees regard dioxins as a probable human carcinogen (that is, it can probably cause cancer in humans).
- Emissions of dioxins from municipal solid waste incinerators can increase levels of dioxins in soil, although the present generation of incinerators release much smaller amounts of dioxins than was the case five or ten years ago. Dioxins from an incinerator in an industrial environment will only slightly increase the total deposition of dioxins.

[9] Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes, Extended Summary, May 2004

- The health effects report found that an incinerator located in a relatively clean rural environment could significantly increase the dioxin deposition above the much lower background level. Even then, the increase would only affect the immediate vicinity of the plant, and would not be expected to be a concern with regard to health.

Appendix 16
Literature review findings- greenhouse gas emissions from waste management

Background

In the life-cycle of manufactured goods and food production, waste management comes at the end of the chain post-raw material acquisition, manufacture, distribution and consumption.

Once a product has been used, it can be recycled into new products. While manufacturing products from recycled inputs still requires energy, fewer raw materials are generally necessary. GHG emissions can therefore be offset by the avoided fossil-fuel use for raw material acquisition. In addition, for products that require wood or paper inputs, recycling can reduce the need to cut down trees, increasing carbon sequestration in forests.

In general terms, greenhouse gas (GHG) emissions are more widely considered in the context of their contribution to global concentrations (e.g. the increase in atmospheric $C0_2$ concentrations in part per million). Associated environmental consequences are complex and may, for example, result in coastal erosion from sea level rise remote from the main release sources.

If a product is not recycled at the end of its useful life, it typically goes through one of a number of waste management options, for example: composting, combustion and landfill. All three use energy for transporting and managing the waste, and produce additional GHGs to varying degrees.

The major impact of the Landfill Directive will be the change of composition and mass of MSW being landfilled. Currently about 60-68% of MSW is biodegradable, and landfill is therefore a major contributor to the production of the methane, when landfilled.

UK greenhouse gases in context

In 2005-06, UK waste management accounted for 0.08% of carbon dioxide emissions, 40.9% of methane emissions and 3.2% of nitrous oxides emissions[10]. However, these methane emissions can be substantially reduced where landfill gas is collected and burned, ideally with energy recovery.

Greenhouse gas emissions

There is little published literature which considers the greenhouse gas emissions associated with waste management. Most often data sets are contained in life-cycle assessment models where copyright issues make data interrogation difficult.

A 2008 report commissioned by the GLA considers the GHG impacts of waste management scenarios uses life-cycle assessment methods. The study's main aim was to measure and rank a range of over 20 residual waste management scenarios with regard to their performance on GHG emissions.

Each scenario considered includes a number of waste management technologies including anaerobic digestion (AD), gasification, incineration and landfill. Co-firing of SRF in cement kilns was not included due to 2 constraints for London (i.e. significant distances to the nearest cement works and contracts may not be sustainable in the long-term.)

The results are set out in Chart A of the report – included below. The performance of each scenario is expressed in kilograms of carbon dioxide-equivalent per tonne of waste treated. The scenarios reflect a mix of proven technologies and others still largely in the

[10] http://www.defra.gov.uk/environment/statistics/globatmos/download/xls/ghg_annex_b_20080327.xls

development phase, in an attempt to report exemplar technology configurations that have the potential to deliver both greenhouse gas benefits and that fit with wider policy goals nationally and regionally.

It is reported that the best performing scenarios were those based on either mechanical biological treatment (MBT) followed by AD, or on gasification preceded by autoclave, coupled with hydrogen fuel cell technologies. These scenarios performed particularly well due to MBT or autoclave processes capturing materials suitable for recycling from the waste stream. The results show that recycling, particularly of plastics, makes a considerable difference to GHG impacts by avoiding emissions from virgin manufacturing processes.

All of the scenarios that incorporated hydrogen fuel cell technologies were reported to perform well due to the greater conversion efficiencies of fuel cells when compared to other energy generation technologies. Biogas produced from AD and syngas produced from gasification can be used in either a gas engine or hydrogen fuel cell to generate energy. The use of biogas in fuel cells is claimed to be proven at commercial scale for stationary power generation. MBT/AD scenarios coupled with gas engines to generate energy might currently be affordable to local authorities and, in the right configurations, be practical technologies for use today. However there has been limited research into the use of syngas derived from MSW in hydrogen applications.

Scenarios using incineration were amongst the poorest performing and were considerably worse than the best performers. This is reported as being largely due to low levels of recycling along with significant emissions from combustion of plastics, which negates the benefits of emission savings from energy generation. A key advantage of AD and gasification over incineration is that they can be coupled with more efficient generation technologies, whilst incineration remains locked to the use of a steam turbine.

It is important to point out the limitations of the report which does not assess:

- whether some of the more complex scenarios will perform effectively in practice;
- costs or gate fees associated with any of the scenarios; and
- alternative environmental impacts (i.e. restricted to GHG).

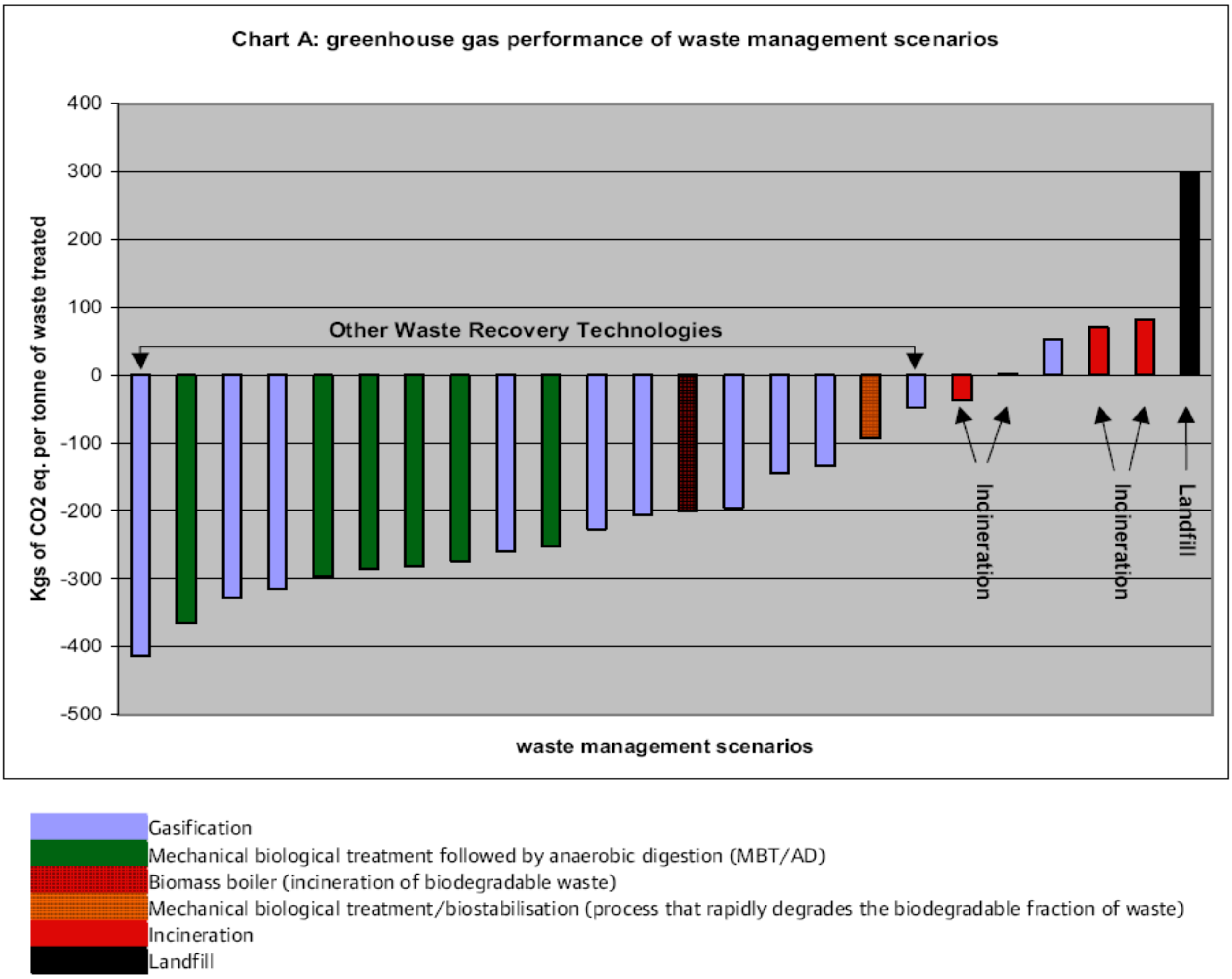
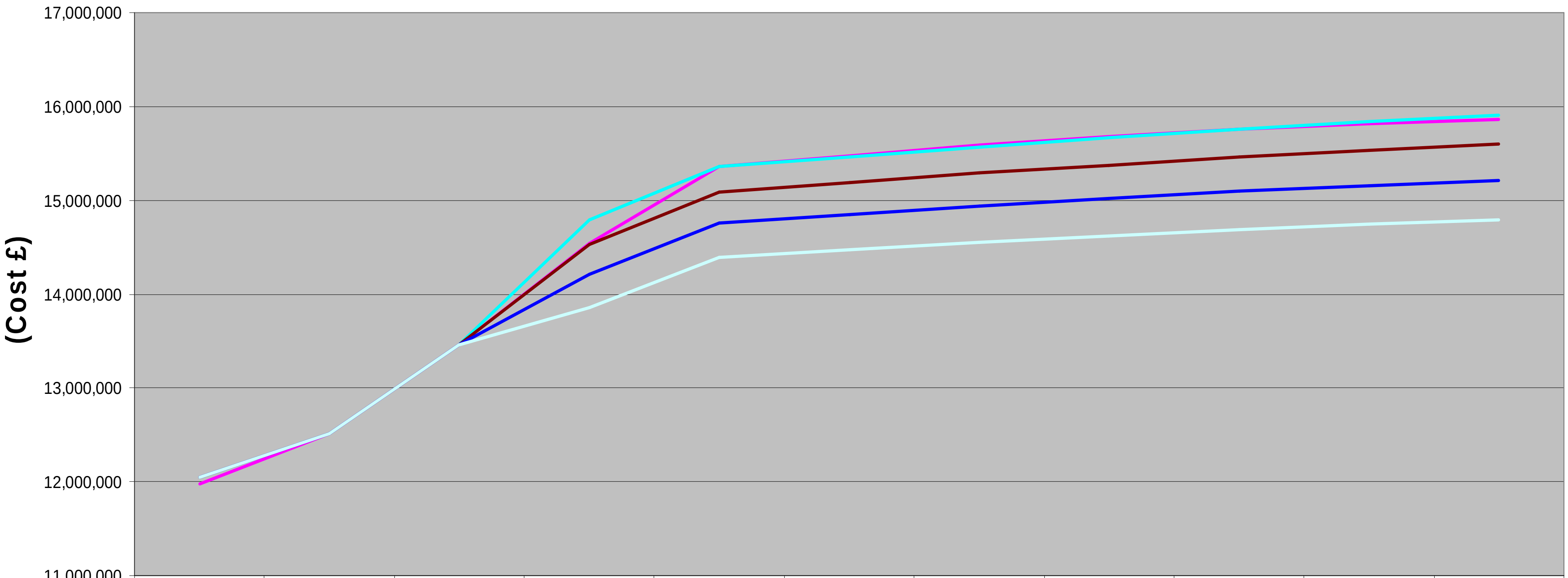


Chart A: greenhouse gas performance of waste management scenarios
400
300
200
100
0
-100
-200
-300
-400
-500
Kgs of CO2 eq. per tonne of waste treated
Other Waste Recovery Technologies
Incineration
Incineration
Landfill
waste management scenarios
Gasification
Mechanical biological treatment followed by anaerobic digestion (MBT/AD)
Biomass boiler (incineration of biodegradable waste)
Mechanical biological treatment/biostabilisation (process that rapidly degrades the biodegradable fraction of waste)
Incineration
Landfill

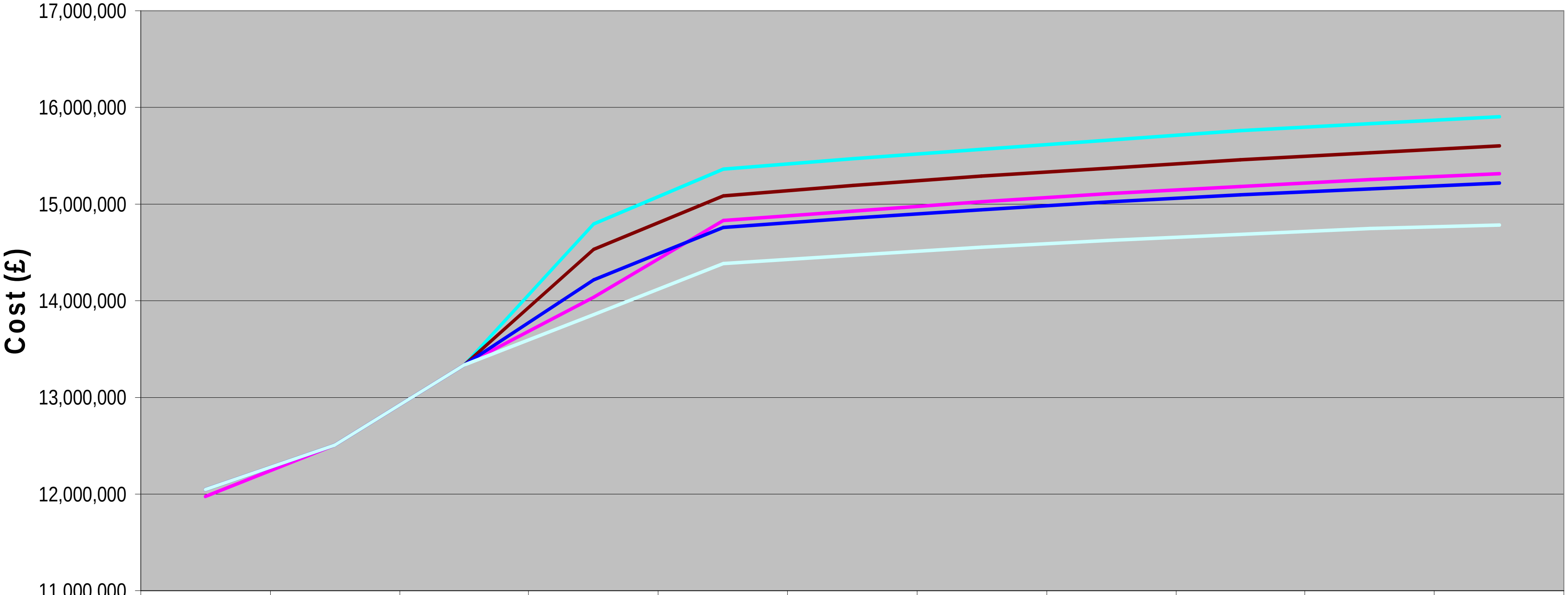
Appendix 17
Projected costs of preferred scenario (40kt by 2012/13 and meeting waste reduction targets and continual improvement in recycling and composting) - LATS Value £50 in 2012/13 and £85 in 2019/20



	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Base	£11,975,142	£12,508,598	£13,457,672	£14,539,627	£15,359,985	£15,478,156	£15,583,716	£15,675,855	£15,753,524	£15,815,834	£15,861,797
EfW	£12,052,260	£12,508,598	£13,457,672	£14,790,719	£15,356,756	£15,466,325	£15,569,570	£15,666,006	£15,755,122	£15,836,382	£15,909,222
Gasification	£12,052,260	£12,508,598	£13,457,672	£14,527,784	£15,088,075	£15,191,114	£15,287,666	£15,377,242	£15,459,327	£15,533,380	£15,598,832
RDF	£12,052,260	£12,508,598	£13,457,672	£14,212,633	£14,754,602	£14,849,742	£14,938,197	£15,019,474	£15,093,052	£15,158,386	£15,214,900
Autoclave	£12,052,260	£12,508,598	£13,457,672	£13,856,042	£14,388,565	£14,474,023	£14,552,554	£14,623,659	£14,686,810	£14,741,456	£14,787,017

Year

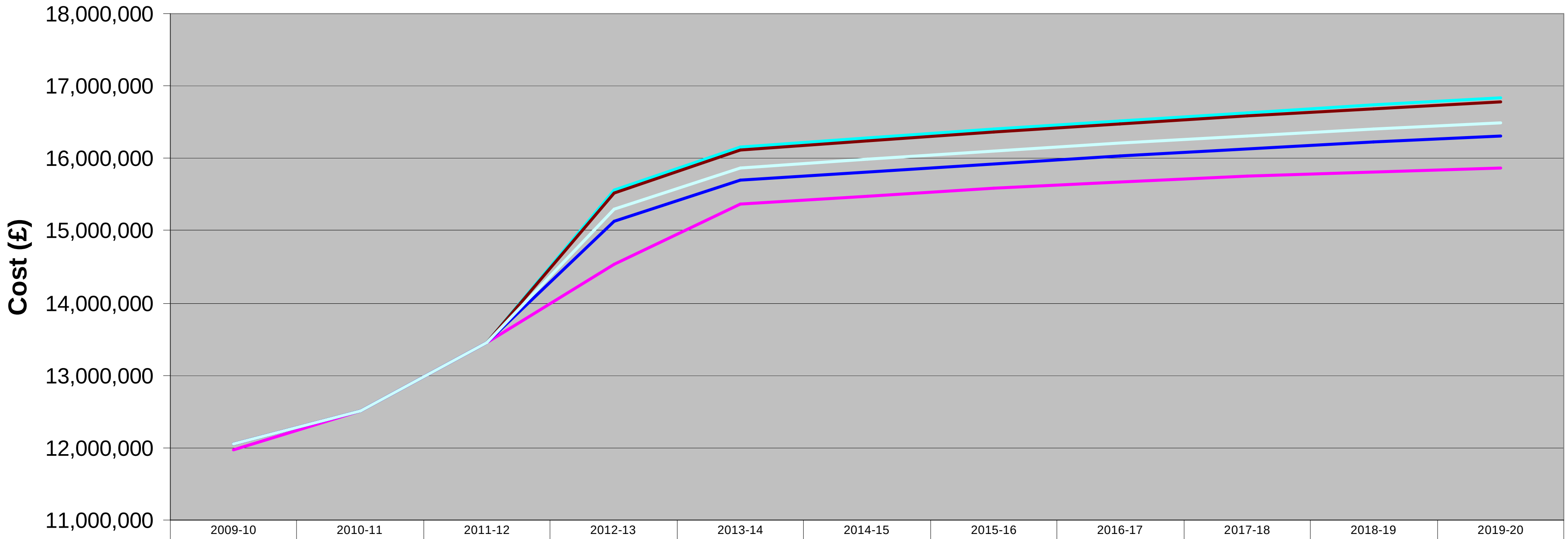
Appendix 18
Projected costs of preferred scenario (40kt by 2012/13 and meeting waste reduction targets and continual improvement in recycling and composting) - LATS no value



	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Base	£11,975,142	£12,508,598	£13,333,338	£14,041,800	£14,835,498	£14,932,660	£15,023,189	£15,106,590	£15,182,346	£15,249,912	£15,308,715
EfW	£12,052,260	£12,508,598	£13,333,338	£14,790,719	£15,356,756	£15,466,325	£15,569,570	£15,666,006	£15,755,122	£15,836,382	£15,909,222
Gasification	£12,052,260	£12,508,598	£13,333,338	£14,527,784	£15,088,075	£15,191,114	£15,287,666	£15,377,242	£15,459,327	£15,533,380	£15,598,832
RDF	£12,052,260	£12,508,598	£13,333,338	£14,212,633	£14,754,602	£14,849,742	£14,938,197	£15,019,474	£15,093,052	£15,158,386	£15,214,900
Autoclave	£12,052,260	£12,508,598	£13,333,338	£13,856,042	£14,388,565	£14,474,023	£14,552,554	£14,623,659	£14,686,810	£14,741,456	£14,787,017

Year

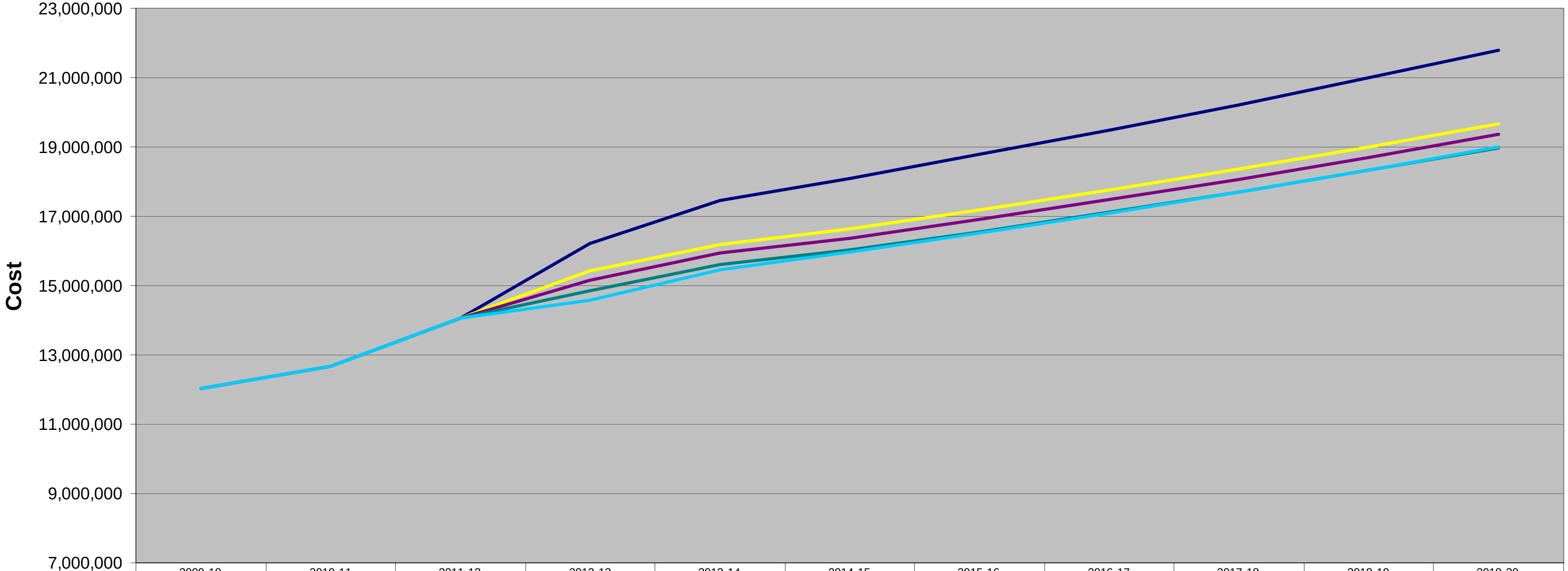
Appendix 19
Projected costs of preferred scenario (40kt by 2012/13 and meeting waste reduction targets and continual improvement in recycling and composting) - LATS Value £50 in 2012/13 and £85 in 2019/20, Standard Gate Fee £100/tonne



	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Base	£11,975,142	£12,508,598	£13,457,672	£14,539,627	£15,359,985	£15,478,156	£15,583,716	£15,675,855	£15,753,524	£15,815,834	£15,861,797
EfW	£12,052,260	£12,508,598	£13,457,672	£15,566,081	£16,151,501	£16,280,939	£16,404,549	£16,521,860	£16,632,372	£16,735,564	£16,830,883
Gasification	£12,052,260	£12,508,598	£13,457,672	£15,523,908	£16,109,101	£16,237,666	£16,360,383	£16,476,777	£16,586,350	£16,688,578	£16,782,910
RDF	£12,052,260	£12,508,598	£13,457,672	£15,131,048	£15,695,978	£15,814,652	£15,927,230	£16,033,233	£16,132,155	£16,223,466	£16,306,608
Autoclave	£12,052,260	£12,508,598	£13,457,672	£15,293,691	£15,862,155	£15,984,453	£16,100,745	£16,210,554	£16,313,378	£16,408,688	£16,495,929

Year

Appendix 20
Projected costs of static waste levels and recycling and 40kt residual treatment by 2012/13 - LATS Value £50 in 2012/13 and £85 in 2019/20



	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Base	£12,018,224	£12,653,971	£14,063,387	£16,205,154	£17,450,354	£18,098,738	£18,776,828	£19,484,943	£20,223,205	£20,991,943	£21,791,426
EfW	£12,018,224	£12,653,971	£14,063,387	£15,412,303	£16,193,107	£16,639,072	£17,184,845	£17,760,736	£18,366,868	£19,003,572	£19,671,121
Gasification	£12,018,224	£12,653,971	£14,063,387	£15,149,367	£15,924,426	£16,363,861	£16,902,941	£17,471,972	£18,071,073	£18,700,570	£19,360,730
RDF	£12,018,224	£12,653,971	£14,063,387	£14,834,216	£15,590,953	£16,022,489	£16,553,473	£17,114,204	£17,704,798	£18,325,576	£18,976,799
Autoclave	£12,018,224	£12,653,971	£14,063,387	£14,575,477	£15,440,904	£15,958,770	£16,505,830	£17,082,389	£17,688,556	£18,324,646	£18,990,915

Year

CONTROL VERSION 4 – 7th January 2009

Appendix 21

Extract from Neighbourhood Services Risk Register November 2008

Reference and Date Raised	4.04.08 NHS 002
Source/ Driver	Strategic Priority Environment, Sustainability & Transport Strategic Aim(s) 1, 2, 3 NI 193, EST SA 1
Risk Description	Failure to comply with landfill Allowance Trading Scheme targets in 2009/10 onwards **Cause(s)** NCC Waste Management Strategy and agreement to technologies/solutions not agreed by stakeholders **Impact(s)** Financial penalties from landfill allowance scheme for excess waste (potentially £150 per tonne) Reputational damage
Risk Category	Envirom
Responsibility	Rob Nichols
Current Controls	- Waste Management Strategy - Agreed targets and front end revised services agreed by Executive September 07 - Appointment of Sustainability Engagement Officer and development of associated Recycling Engagement Strategy - Partnership with BAN Waste - joint work around waste minimisation and recycling - Existing MBT facility with external partner SITA - Recently appointed external partner on recycling processing - Strategic Environmental assessment public consultation - New waste collection process - Collaboration with North Tyneside
Effectiveness of Current Controls	Limited
Likelihood	Medium
Impact	Medium
Current Risk Priority	**9**
Target Risk Priority	**6**
Actions Required	Report to be agreed by Executive on future waste technologies. Communication & Enforcement Team -Engagement Strategy under development
Action Owner	Rob Nichols/Les Clark
Date Expected	Jan-09
Review information/ notes	Looking at alternative technologies – study tour to UK and Norway March 2008 Reviewed by Rob Nichols on 22 July 08 Reviewed by Rob Nichols 23 Nov 08 - Risk Priority reduced to Amber & Executive Report is now expected Jan 08 Risk Advisor has revised target risk priority following discussions
Risk Status	Current