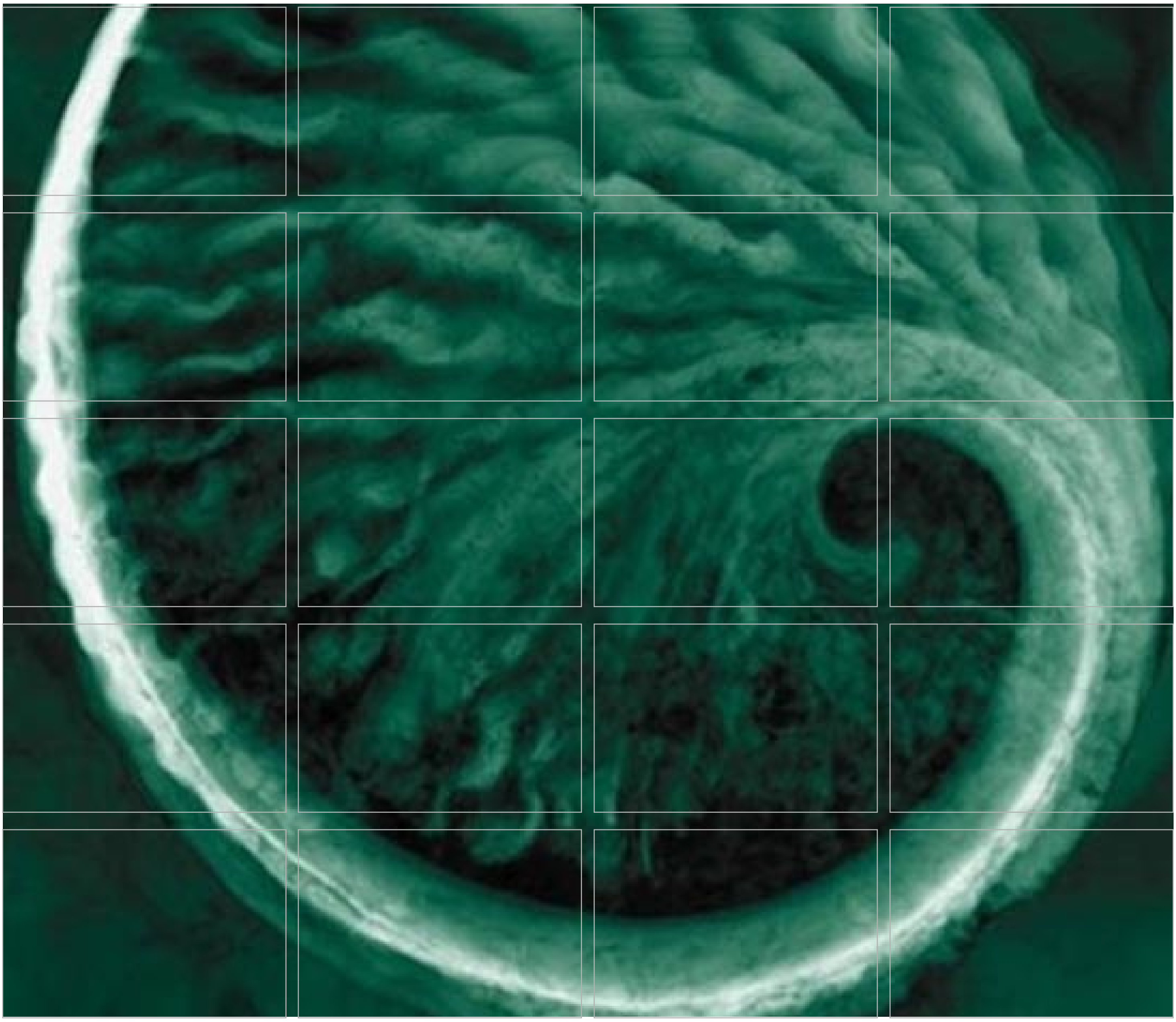


# Recycling & Compositing Appraisal

Annex 4

Report

March 2006

Delivering sustainable solutions in a more competitive world

ERM

Kent Waste Forum

# Recycling & Composting Appraisal

## Annex 4

## Report

March 2006

Prepared by Natalie Riches & Cathal O'Leary

For and on behalf of
Environmental Resources Management

Approved by: Simon Aumônier

Signed:

Position: Partner

Date: 31st March 2006

# 1 RECYCLING & COMPOSTING OPTIONS

## 1.1 INTRODUCTION

The development of a municipal waste management strategy for Kent involves taking a series of strategic decisions. These decisions are responses to questions relating to what is to be achieved through the Strategy, what methods can be used to meet these aims and what are the potential impacts of achieving these aims. The objective of this modelling exercise is to inform strategic decisions regarding the Kent Waste Partnership's opportunities for raising recycling and composting performance and for meeting their challenging statutory targets.

A series of strategic options for the development of recycling and composting services across the County have been developed. These present collection systems that have the potential to be implemented individually, or in combination, to increase incrementally recycling and composting performance. They are not intended in any way to be prescriptive, and they present only indicative routes for achieving increased recycling performances. This report will inform the Kent Authorities' decisions as to how to develop their recycling and composting services and where resources and effort are best placed.

Having identified strategic options, methods were developed to appraise them objectively against a number of environmental, social and economic criteria. The purpose of this rigorous approach to options appraisal is to assist Kent's Authorities with the strategic decision-making process by identifying the potential environmental, social and financial costs of each option.

## 1.2 CRITERIA SELECTION

A technical options appraisal requires that the performance of alternative options be assessed against key objectives, reflected through a range of criteria, in order to identify the option (or options) that perform best overall.

The criteria will not only be used to indicate the environmental impacts of the options, but also how they perform in relation to deliverability and cost.

As a basis for criteria selection, the Sustainability Appraisal (SA) Objectives produced in relation to the development of the Waste Development Framework (WDF) were reviewed. Some of these concerned more site-specific issues, and thus were not appropriate for a strategic level waste Strategy.

Workshops were held with each of the Districts and Kent County Council (KCC) to identify the assessment criteria appropriate for Kent. These were then put forward to the Kent Waste Forum for final agreement.

The assessment criteria selected are shown in the table below.

*Table 1.1* *Options Appraisal Criteria*

| SA Objectives | Assessment Criteria | | Comments |
|---|---|---|---|
| To ensure that everyone has the opportunity to live in a decent, sustainably constructed home | N/A | | Not applicable to a strategic level MSW Strategy |
| To reduce the risk of flooding and the resulting detriment to public well being, the economy and the environment. | N/A | | This objective is only relevant when dealing with site specific issues and is largely dependant on location. This will therefore not be applied at a strategic level |
| To improve the health and well being of the population and reduce inequalities in health | **Health Impact - emissions injurious to human health** | ✓ | |
| To reduce crime and the fear of crime | N/A | | Not applicable to a strategic level MSW Strategy |
| To improve accessibility to all services and facilities | **Accessibility to Services** | ✓ | |
| To improve efficiency in land use | **Landuse Impacts** | ✓ | |
| To reduce air pollution and ensure air quality continues to improve; | **Air Pollution** | ✓ | |
| and to address the causes of climate change through reducing emissions of greenhouse gasses and ensure Kent is prepared for its impacts | **Emissions of Greenhouse Gases** | ✓ | |
| To conserve and enhance Kent's biodiversity | N/A | | This objective is only relevant when dealing with site specific issues and is largely dependant on location. This will therefore not be applied at a strategic level |
| To protect, enhance and make accessible for enjoyment, Kent's countryside and coast, and its historic environment | N/A | | This objective is only relevant when dealing with site specific issues and is largely dependant on location. This will therefore not be applied at a strategic level |
| To reduce road traffic and its impacts, promote sustainable modes of transport and reduce the need for travel by car or lorry | **Impacts of Road Transportation** | ✓ | |
| To reduce the global, social and environmental impact of consumption of resources by using sustainably produced and local products and services | **Impact of Resource use (Resource Depletion)** | ✓ | |
| To reduce waste generation and disposal and achieve sustainable waste management | **Compatibility with the Waste Hierarchy** | ✓ | |
| | **Reliability of Delivery** | ✓ | |
| | **Liability of End Product** | ✓ | |
| To maintain and improve the water quality of Kent's rivers, coasts and groundwater | **Impact on Water Pollution** | ✓ | |

| SA Objectives | Assessment Criteria | | Comments |
|---|---|---|---|
| To increase energy efficiency and the proportion of energy generated from renewable sources in Kent | **Energy generation and consumption** | ✓ | |
| To build a strong and stable economy which provides prosperity and opportunities for all | **Number of jobs created** | ✓ | |
| | **Financial Cost** | ✓ | |

## 1.3 *OPTION DEVELOPMENT*

The recycling and composting options assessed in this report were identified through consultation with the Kent Waste Forum and the wider stakeholder network.

The Kent Waste Open Forum held in October 2005 enabled stakeholders to provide input into what they would like to see provided in recycling and composting services in Kent. Feedback from wider public consultation, undertaken in conjunction with the WDF, was reviewed and incorporated into the options. Workshops were then run with each of the Districts and KCC to derive the list of potential options.

The table below details the recycling and composting options developed. Each option builds upon the baseline collection system to provide additional capacity and/or to achieve higher rates of recycling and composting. The options modelled were selected to present an understanding of what recycling levels could be achieved if additional materials were collected.

Unlike some other options appraisals, it is unlikely that one option will be chosen as 'the best'. It is expected that a combination of a number of options provided will be taken forward into the Strategy on the basis of the balance of advantages and disadvantages that is demonstrated through the appraisal.

***Table 1.2 Recycling and Composting Options***

| | |
|---|---|
| Option A | Raise participation and capture rates of current recycling collections to 80% |
| Option B | Increase coverage of recycling and composting collections to 100% and increase participation and capture to 80%. |
| Option C | Expand glass collections to all households. |
| Option D | Introduce compostable kitchen waste collections to all households. |
| Option E | Expand garden waste collections to all relevant households. |
| Option F | Expand the current cardboard collections to all households. |
| Option G | Collect dense and film plastics from 100% of households. |

| | |
|---|---|
| Option H | Collect tins and cans from 100% of households. |
| Option I | Add kitchen and cardboard to current garden waste collections. |
| Option J | Collect commingled plastics and tins and cans from 100% of households. |
| Option K | Increase recycling at bring sites by 15%. |
| Option L | Increase recycling at bring sites by 20%. |
| Option M | Expand the range of bring sites to include dense and film plastics. |
| Option N | Increase recycling at the HWRCs to 60%. |
| Option O | Increase recycling at the HWRCs to 75%. |

The principal assumptions made for each option during the modelling are set out below.

### *1.3.1 Option A*

Under this scenario, the rate of participation and capture of all kerbside collections was set to 80%. The levels of recycling at bring sites and HWRCs were held at baseline levels as the quantity of material recycled did not exceed the level of potentially recyclable material.

### *1.3.2 Option B*

The range of materials collected at the kerbside was expanded to 100% of households throughout Kent. The collection methods, ie commingled or kerbside sorted, were kept in the same proportion as in the baseline. The quantity of garden waste collected was increased in line with the quantity of garden waste collected in the baseline scenario.

### *1.3.3 Option C*

This option envisages the introduction of a separate glass collection to all the households in the County. Participation and capture rates of the collection were set at 60%.

### *1.3.4 Option D*

The increasing diversion of biodegradable municipal waste from landfill is necessary for Kent to achieve its Landfill Allowance Trading Scheme targets. This option assumes that there is sufficient processing capacity available to treat compostable kitchen waste in-vessel. The participation and capture rates for this material were set at 60%.

### *1.3.5 Option E*

A variety of garden waste schemes currently operate in several Districts across Kent. This option examines the effect of expanding garden waste collections to all relevant households in Kent. The participation and capture rates of the current schemes are far greater than 60%. The quantity of garden waste collected was extrapolated from the current collections to estimate the collections in this option. Garden waste tonnages collected at HWRCs were kept at baseline levels.

### *1.3.6 Option F*

The current cardboard collections were expanded to include the remaining households in the County. It was assumed that the current level of cardboard participation and capture being achieved would remain constant and that the additional households included on the scheme would have participation and capture rates of 60%. The additional cardboard was assumed to have been collected commingled with other items.

### *1.3.7 Option G*

Option G introduces plastics recycling to 100% of households across the County. Dense and film plastics were included in the collections. Participation and capture rates are for both types of plastic were 60%.

### *1.3.8 Option H*

A collection covering 100% of households of ferrous and non-ferrous cans was modelled in this option. Participation and capture rates were set at 60%.

### *1.3.9 Option I*

Garden waste is currently collected from 41% of households across the County. This option models the effect of including cardboard and compostable kitchen waste in these collections. This option assumes that there is sufficient processing capacity available to treat all of this waste by in-vessel composting.

### *1.3.10 Option J*

This option introduced a commingled collection of cans and plastics to 100% of households with participation and capture rates of 60%. It was assumed that there was sufficient MRF capacity available to process the additional tonnages collected.

### *1.3.11 Option K & L*

This option examined the effect of increasing the tonnages of recyclables collected at recycling banks around Kent. The number of banks was held at baseline levels but the tonnages collected were increased by 15% and 20% respectively. It was assumed that the quantity of plastic collected at the kerbside was not affected by the increase in bring tonnages.

### 1.3.12 *Option M*

This option assessed the impact of collecting plastics at bring sites. It was assumed that the number of plastic banks installed and their capture rate was equal to that of glass banks. It was assumed that the quantity of plastic collected at the kerbside was not affected by the increase in bring tonnages.

### 1.3.13 *Option N & O*

These options increased the level of BVPI recycling at the HWRCs in Kent to 60% and 75% respectively. The quantity of waste entering the HWRC was assumed to be equal to the baseline. It was also assumed that the level of kerbside and bring recycling remained constant and that the there was sufficient recycling capacity at the HWRCs to process the additional tonnages collected.

## 1.4 OPTIONS IMPACT ON RECYCLING LEVELS

The table below shows the potential recycling and composting levels that could be achieved with each option. These will be examined in more detail later on in the report.

**Table 1.3 BVPI Recycling Increase 2005-2025**

| Option | BVPI Recycling Increase over Baseline (tonnes) | Percentage BVPI Recycling Increase over Baseline |
|---|---|---|
| A | 108,160 | 1.00% |
| B | 1,854,442 | 9.95% |
| C | 239,396 | 1.29% |
| D | 1,010,332 | 5.42% |
| E | 1,027,052 | 5.51% |
| F | 25,543 | 0.14% |
| G | 245,,717 | 1.32% |
| H | 201,071 | 1.08% |
| I | 579,070 | 3.11% |
| J | 281,893 | 1.51% |
| K | 99,042 | 0.53% |
| L | 132,056 | 0.71% |
| M | 204, 845 | 1.10% |
| N | 676,645 | 3.63% |
| O | 1,255,013 | 6.73% |

### 1.5 *APPRAISING THE OPTIONS AGAINST PERFORMANCE CRITERIA*

This section explains the methods used for assessing the performance of strategic options against each criterion, as well as presenting the results of the appraisal.

#### 1.5.1 *Environmental Criteria – Scope of Assessment*

A life cycle approach has been used to assess the performance of options against a number of criteria:

- resource depletion;
- energy consumption;
- greenhouse gas;
- acidification; and
- human health.

This approach is useful to gain an overall picture of the relative performance of options. It allows consideration of the potential impact of targeting alternative materials for recycling/composting, together with any knock-on implications for the disposal of residuals wastes.

A number of activities in the waste management life cycle may cause, or avoid, potential environmental impact. These activities include:

- **waste processing** (eg at materials recycling facilities (MRFs), transfer stations, composting plant). Facilities consume quantities of electricity and diesel to power machinery. In turn, resources were consumed and emissions released in the generation of these power sources;
- **waste disposal** (landfill). Landfill sites consume quantities of electricity and diesel to power machinery and result in releases of methane, leachate and other emissions with potential environmental impact. Conversely, some of the methane produced by biodegrading waste can be captured and used to generate electricity, thereby offsetting grid electricity production;
- **recycling and composting**. In recycling, for example aluminium, there are significant energy savings by comparison with the extraction of aluminium from bauxite. The burdens of recycling versus virgin production are ascertained so that the difference can be credited to materials recycling/composting processes; and
- **waste transport**. Significant amounts of fuel are used in moving waste from facility to facility, and these must be included the quantification of impacts.

In order to quantify the potential impacts of these activities, ERM calculated the resource requirements (tonnes of diesel, kWh of electricity, tonne-kilometres of waste transported etc.) of the various facilities and processes involved in each option. Impact factors, which describe the potential impact per tonne of, for example, diesel consumed or material recycled, were then applied in order to determine the impacts associated with the activities. These impact factors are presented in *Annex A.*

Methods for calculating impact factors differ according to the criterion being assessed, and so are described in more detail in the following sections. A summary table of results is given at the end of this section.

### 1.5.2 *Impact of Resource Use (Resource Depletion)*

Resource depletion is an important concern because current levels of consumption of non-renewable resources are thought to be unsustainable. Non-renewable resources, such as crude oil, coal and gas, are natural, and essentially limited.

*Methods and Assumptions Used*

The Environment Agency's life cycle assessment software tool for waste management, WISARD, determines non-renewable resource depletion as the 'Abiotic Depletion Factor' (ADF) for the extraction of individual minerals and fossil fuels. This is based on the current concentration of reserves and their rate of de-accumulation. For this assessment, we have simplified the process by assessing the depletion of coal, natural gas and crude oil as proxies for the ADF. Since these are the major resources affected by the options assessed, it is assumed that this represents a valid means of performing the assessment.

Coal, natural gas and crude oil depletion factors for alternative waste management activities (presented in *Annex A*) were used to calculate the consumption of these resources associated with each option. Figures for the three depleted materials (coal, crude oil and natural gas) were then converted into a common equivalent, using *CML 2000* (1) resource depletion factors, as shown in *Table 1.4*, to generate a single figure representing the resource depletion of each of the options, in terms of '*tonnes of crude oil equivalents*'.

**Table 1.4** ***Resource Depletion Conversion Factors*** (†)

| Resource | 1 kg crude oil | Units |
|---|---|---|
| Coal | 1.500 | kg |
| Natural gas | 1.075 | $m^3$ |
| Crude oil | 1 | kg |

(†) Data from CML 2000

*Results*

Resource depletion results are presented in *Table 1.5*, expressed as a cumulative depletion of crude oil equivalents over the assessment period, 2005/6 to 2024/25.

(F1) CML 2000 - Centre of Environmental Science - Leiden University (CML), Leiden, The Netherlands.

*Table 1.5 Resource Depletion Scores (Tonnes of Crude Oil Equivalents)*

| Option | Total | Rank (1 = best performing) |
|---|---|---|
| **A** | -1,370,784 | **5** |
| **B** | -1,954,915 | **1** |
| **C** | -1,185,431 | **9** |
| **D** | -1,119,840 | **13** |
| **E** | -1,113,608 | **14** |
| **F** | -1,092,690 | **15** |
| **G** | -1,438,716 | **4** |
| **H** | -1,264,630 | **7** |
| **I** | -1,169,487 | **10** |
| **J** | -1,532,121 | **3** |
| **K** | -1,151,713 | **12** |
| **L** | -1,160,974 | **11** |
| **M** | -1,775,430 | **2** |
| **N** | -1,235,689 | **8** |
| **O** | -1,331,218 | **6** |

Results show that the resource recovery benefits of materials recycling and landfill gas recovery outweigh the resource depletion costs of waste processing and transport for each of the strategic options assessed, such that total resource depletion scores are negative. It follows that option B, the single option involving the greatest recovery of materials for recycling/composting, delivers the most significant resource depletion benefit.

In order to differentiate between the other indicative options, it is necessary to consider the nature of materials targeted for recovery. Options G, J and M all target the increased recovery and recycling of plastics. The production of virgin plastics is resource intensive, particularly in terms of oil consumption, and so efforts to increase the availability of secondary materials have high associated resource benefits.

In comparison, options D, E and F target materials which deliver a significantly lower resource depletion benefit as the virgin materials they displace (compost or virgin cardboard/paper) have a relatively lower resource depletion impact.

It is a point of note that options N and O, both of which result in significant additional tonnages recycled/composted (in excess of 600,000 tonnes over the assessment period), perform only moderately well against this assessment criterion. This results as the majority of tonnage recycled is aggregate material, which has low associated resource depletion benefits.

### 1.5.3 *Air Pollution (Acidification)*

Acidification is the process whereby air pollution (mainly ammonia, sulphur dioxide and nitrogen oxides emissions) results in the deposition of acid substances. 'Acid rain' is best known for the damage it causes to forests and lakes. Less well known are the many ways it affects freshwater and coastal ecosystems, soils and ancient monuments. Acid deposition can increase the environmental mobility of metals, resulting in the pollution of water sources and increased uptake of metals by fauna and flora.

Gases contributing to acidification are weighted according to their acidification potential. These weightings have been developed for potentially acidifying gases such as $SO_2$, $NO_x$, HCl, HF and $NH_3$, on the basis of the number of hydrogen ions that can be produced for a given amount of a substance, using $SO_2$ as the reference substance.

*Methods and Assumptions Used*

Extensive experience by ERM and others in assessing the acidification impact of integrated waste management processes has found $SO_2$ emissions to be the greatest contributor to the acidification impact, with $NO_x$ emissions the second largest contributor [(1)]. Both $NO_x$ and $SO_2$ emissions are the result of combustion processes and the emission of one is considered an indicator for the presence of the other [(2)].

When determining the contribution to acidification impact, 1kg of $SO_2$ has a greater acidifying impact than 1kg of $NO_x$[(3)]. Hence for this study, we have focused solely on $SO_2$ emissions as a proxy for all the acidifying gases. It is assumed that $SO_2$ emissions are a satisfactory indicator of the overall acidification potential of the options.

$SO_2$ emission factors for activities in the waste management life cycle were used to calculate impact scores, as described in *Section 1.5.1*. These emission factors are presented in *Annex A*.

*Results*

Air pollution (acidification) results are presented in *Table 1.6*, expressed as cumulative emissions of $SO_2$ over the assessment period, 2005/6 to 2024/25.

(1) Enviros Aspinwall (January 2002) arc21 - Consultation Waste Management Plan
(2) http://www.aeat.co.uk/netcen/airqual/naei/annreport/annrep99/index.htm [05Jan05 @ 11:44]
(3) CML 2 Baseline 2000, Institute of Environmental Sciences (CML), University of Leiden, the Netherlands, 2000.

*Table 1.6* *Air Pollution (Acidification) Scores (Tonnes of $SO_2$)*

| Option | Total | Rank (1 = best performing) |
|---|---|---|
| **A** | -16,190 | **5** |
| **B** | -20,137 | **1** |
| **C** | -14,655 | **9** |
| **D** | -14,057 | **13** |
| **E** | -14,025 | **14** |
| **F** | -13,965 | **15** |
| **G** | -15,540 | **7** |
| **H** | -16,128 | **6** |
| **I** | -14,588 | **10** |
| **J** | -17,070 | **2** |
| **K** | -14,442 | **12** |
| **L** | -14,561 | **11** |
| **M** | -16,382 | **3** |
| **N** | -15,300 | **8** |
| **O** | -16,339 | **4** |

Results show that the avoidance of acidification impacts through materials recycling outweigh the acidification costs of waste processing and transport for each of the strategic options assessed, such that total acidification scores are negative. It follows that option B, the single option involving the greatest recovery of materials for recycling/composting, delivers the most significant acidification benefit.

In order to differentiate between the other indicative options, it is again necessary to consider the nature of materials targeted for recovery. High-performing options are discriminated by the quantity of non-ferrous metals and plastics separated for recycling, as these materials deliver significant acidification benefits through the displacement of virgin materials. In this way, options J, M and O in particular perform well.

As found for the resource depletion criterion, options D, E and F target materials which deliver a lower acidification benefit as the virgin materials they are assumed to displace (compost, or virgin cardboard/paper) have a relatively lower acidification impact.

### *1.5.4 Emission of Greenhouse Gases*

Human activities have altered the chemical composition of the atmosphere through the build-up of greenhouse gases, primarily $CO_2$, $CH_4$, and $N_2O$. The higher the concentration of these gases, the higher the heat-trapping capability of the earth's atmosphere.

*Methods and Assumptions Used*

Gases contributing to the greenhouse effect are weighted according to their impact on radiative warming, compared to $CO_2$ as the reference gas. Weighing factors as developed by the Intergovernmental Panel on Climate Change (IPCC) were selected. These figures are shown in *Table 1.7*.

***Table 1.7*** ***Greenhouse Gas Characterisation Factors*** ***(†)***

| Gas | Formula | Characterisation factor | Units |
|---|---|---|---|
| Carbon dioxide | $CO_2$ | 1 | $CO_2$ equivalent |
| Methane | $CH_4$ | 21 | $CO_2$ equivalent |

(†) Factors are expressed as Global Warming Potential for time horizon 100 years (GWP100), in kg carbon dioxide/kg emission.

In accordance with recognised practice for assessing $CO_2$ emissions, a firm distinction is made between 'renewable' and 'non-renewable' sources of $CO_2$, with only the latter (from the combustion of fossil fuels and plastics) taken as making a contribution to the greenhouse gas figures. Clearly, $CO_2$ is $CO_2$: however, it is assumed that the effect of releasing carbon from renewable sources is neutral because these releases are balanced by uptakes in the short-term, mainly in agro-forestry systems. By contrast, releases from non-renewable sources are only balanced out over geologic time periods.

This assessment estimates the effect of the different recycling and composting options on the release of non-renewable greenhouse gas emissions. $CO_2$ and $CH_4$ emission factors for activities in the waste management life cycle (presented in *Annex A)* were used to quantify emissions of these two gases. These were then converted into $CO_2$ equivalents using the figures in *Table 1.7.*

*Results*

Greenhouse gas emission results are presented in *Table 1.8*, expressed as cumulative emissions of $CO_2$ equivalents over the assessment period, 2005/6 to 2024/25.

*Table 1.8* *Greenhouse Gas Emission Scores (Tonnes of $CO_2$ Equivalents)*

| Option | Total | Rank (1 = best performing) |
|---|---|---|
| **A** | -520,039 | **5** |
| **B** | -1,648,446 | **1** |
| **C** | -181,071 | **12** |
| **D** | -262,104 | **10** |
| **E** | -249,560 | **11** |
| **F** | 258 | **15** |
| **G** | -492,790 | **7** |
| **H** | -499,166 | **6** |
| **I** | -300,000 | **9** |
| **J** | -770,263 | **2** |
| **K** | -140,079 | **14** |
| **L** | -163,411 | **13** |
| **M** | -734,127 | **4** |
| **N** | -428,330 | **8** |
| **O** | -734,544 | **3** |

Results show that, for the majority of options assessed, the avoidance of greenhouse gas emissions through materials recycling outweigh emissions resulting from waste processing, disposal and transport. Again, option B, the single option involving the greatest recovery of materials for recycling/composting, accordingly performs well.

The pattern of results for other options is similar to that shown for resource depletion and acidification criteria, with the nature of materials targeted for recovery of key importance. For this criterion, however, options that increase the quantity of metals recycled perform particularly well, as the displacement of virgin metal production is awarded a significant greenhouse gas benefit. In this way options J, O and M perform favourably.

Diversion of biodegradable waste from landfill is also a significant factor affecting performance against this criterion and so options D and E, which target kitchen and green waste perform better than against resource depletion and acidification criteria. Option F, which diverts only small tonnages of cardboard, still performs poorly, however.

### *1.5.5 Energy Consumption*

Energy consumption is a central indicator of sustainability, affecting all aspects of development: social, economic and environmental. In February

2003, the Government's Energy White Paper set energy efficiency at the heart of UK energy policy, identifying improved energy efficiency as the most cost-effective way to meet all of our energy policy goals. By using less energy we can reduce carbon emissions, enhance the security of our energy supplies, improve the competitiveness of UK businesses and reduce fuel poverty [1].

It should be noted that energy consumption is not independent of some other appraisal criteria, for example air pollution, greenhouse gas emissions and transport distance. In reaching decisions as to the preferred options for adoption in the Strategy, the potential for double-counting impacts should be recognised.

*Methods and Assumptions Used*

All waste treatment and disposal activities consume energy, predominantly in the form of either electricity or diesel for machinery operation. In contrast, some activities lead to the direct generation of energy (eg landfill, through the capture and utilisation of landfill gas) or indirect energy savings (eg through materials recycling/composting and the displacement of virgin material production).

The calculation of energy consumption impact scores followed a similar pattern as for the quantification of resource depletion, based on relative consumption of coal, natural gas and crude oil. Since these are the major energy carriers affected by the options assessed, it is assumed that this represents a valid means of performing the assessment.

Coal, natural gas and crude oil depletion factors for alternative waste management activities (presented in *Annex A*) were used to calculate the consumption of these resources associated with each option. Figures for the three fuel sources (coal, crude oil and natural gas) were then converted into a common energy equivalent, based on calorific value. Calorific values for coal, natural gas and crude oil are shown in *Table 1.9*.

***Table 1.9*** ***Resource Calorific Values***

| Resource | Calorific Value | Source |
|---|---|---|
| Coal | 30.3 MJ/kg | BUWAL life cycle database |
| Natural Gas | 60.2 MJ/$m^3$ | Engineering Toolbox (http://www.engineeringtoolbox.com/) |
| Crude Oil | 42.3 MJ/kg | BUWAL life cycle database |

(1) http://www.defra.gov.uk/environment/energy/review/

*Results*

Energy consumption results are presented in *Table 1.10*, expressed as a cumulative consumption/generation of energy (TJ) over the assessment period, 2005/6 to 2024/25.

***Table 1.10 Energy Consumption Scores (TJ)***

| Option | Total | Rank (1 = best performing) |
|---|---|---|
| **A** | -66265 | **5** |
| **B** | -96078 | **1** |
| **C** | -56466 | **9** |
| **D** | -53784 | **14** |
| **E** | -53445 | **15** |
| **F** | -53844 | **13** |
| **G** | -70625 | **4** |
| **H** | -60229 | **7** |
| **I** | -55984 | **10** |
| **J** | -74856 | **3** |
| **K** | -55133 | **12** |
| **L** | -55573 | **11** |
| **M** | -89426 | **2** |
| **N** | -58975 | **8** |
| **O** | -63386 | **6** |

As with the previous environmental criteria, results shows a net energy benefit attributed to each of the strategic options assessed. This results through materials recycling and the additional benefits of energy generation through landfill gas recovery.

Results follow the same pattern seen for resource depletion, as the assessment methodology focused on the consumption of resources in a similar way. Differences are slight, for example the relative positioning of options D, E and F. These relate to the balance of diesel and electricity consumption at processing plant and the alternative methods of characterising the implications of these resource requirements.

### *1.5.6 Impact on Human Health*

The anthropogenic release of chemical compounds to the environment is a major environmental concern due to the potential for harm to humans and the natural environment. For this reason, methods have been developed that estimate the potential harm that may result from emissions of chemical compounds to the environment.

*Methods and Assumptions Used*

The impact assessment methodology used to assess this criterion is derived from the calculation of human toxicity potentials (HTPs) related to the various inputs to and outputs from waste treatment activities, rather than actual health impacts. Human toxicity potentials are based on a calculated index that reflects the potential harm of a unit of chemical released into the environment. These impact factors derive from the Uniform System for the Evaluation of Substances software (USES-LCA), describing fate, exposure and effects of toxic substances for an infinite time horizon and are expressed as 1,4-dichlorobenzene (1,4-DB) equivalents.

Human toxicity potentials for activities in the waste management life cycle were determined and are presented in *Annex A*. These were then scaled according to the resource requirements of each of each option, in order to generate a total impact score.

*Results*

Human health impact results are presented in *Table 1.11*, expressed as the cumulative human toxicity potential (tonnes 1,4-DB equivalents) over the assessment period, 2005/6 to 2024/25. Results have been broken down to show the potential impacts/benefits associated with waste processing and disposal, offset benefits of resource recovery and the impacts of waste transport.

***Table 1.11 Human Toxicity Potential Scores (Tonnes of 1,4-DB Equivalents)***

| Option | Total | Rank (1 = best performing) |
|---|---|---|
| **A** | - 3,946,031 | **4** |
| **B** | - 4,883,060 | **1** |
| **C** | - 2,831,181 | **14** |
| **D** | - 2,845,800 | **9** |
| **E** | - 2,838,764 | **11** |
| **F** | - 2,820,888 | **15** |
| **G** | - 3,067,431 | **8** |
| **H** | - 4,169,739 | **3** |
| **I** | - 3,072,421 | **7** |
| **J** | - 4,176,410 | **2** |
| **K** | - 2,837,017 | **12** |
| **L** | - 2,843,350 | **10** |
| **M** | - 2,834,688 | **13** |
| **N** | - 3,391,613 | **6** |
| **O** | - 3,881,899 | **5** |

Human toxicity results again show the significant potential benefits delivered through materials recycling and composting. Option B, the option involving the greatest recovery of materials for recycling/composting, accordingly delivers the most significant potential benefit.

Assessment results for this criterion follow a slightly different pattern to those previously discussed. Differentiation is again based on the nature of materials separated for recycling/composting; however high-performing options are discriminated principally, and almost exclusively, by the quantity of non-ferrous metals separated for recycling. The production of virgin aluminium generates a significant human toxicity potential, through the release of toxic substances and high electricity consumption. The processing of scrap metal to produce secondary aluminium has much reduced toxicity implications in comparison, such that non-ferrous metal recycling is awarded a considerable toxicity benefit.

Where strategic options lead to an equivalent quantity of non-ferrous metal recycling, differentiation is seen through capture of alternative materials. *Annex A* shows that plastics and glass recycling are awarded a relatively lower offset benefit than for other criteria, and so options C and M perform relatively less favourably.

### *1.5.7 Impact on Water Pollution*

A recent literature review[1] showed that in general there are unlikely to be significant impacts for water quality associated with recycling and composting facilities. Actual impacts are a consequence of the standards of facilities management and the proximity to sensitive receptors, and hence are site dependant.

The Environment Agency's Operator Performance and Risk Appraisal (OPRA) scores (2) assess the potential impact on water pollution from composting sites, MRFs and transfer stations equally. An appraisal of this criterion would not differentiate between the options and therefore is not appropriate at this stage.

### *1.5.8 Road Transportation*

It is a key sustainability objective to reduce road traffic and the need for travel by road. To this effect, an assessment was made of the expected road distance travelled for alternative options, as an indication of the local transport impacts associated with each. This is in addition to the consideration given to the

[1] *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes*, Enviros Consulting Limited et al, March 2004

(2) http://www.environment-agency.gov.uk/commondata/105385/wasteriskinspectv3_133720.pdf

environmental impacts of transport when assessing resource depletion, acidification, greenhouse gas, energy consumption and human health criteria.

*Method and Assumptions Used*

Since the focus of this appraisal is on strategic options for recycling and composting, and subsequent options appraisal work will address residual waste, the assessment of this criterion quantified road travel associated with the collection and processing/reprocessing of materials for recycling and composting only.

To estimate the total road distance travelled for each option, a number of assumptions have had to be made. Although the assessment is not site-specific, assumptions on indicative MRF, transfer and reprocessing locations have had to be made in order to allow transport distances to be calculated. Indicative collection distances made by refuse collection vehicles (RCVs) have been collected from the Kerbside Analysis Tool (KAT) modelling undertaken as part of the assessment of costs. These assumptions are listed in *Annex B*.

To establish the number of lorry movements required to transport materials to reprocessing facilities, the tonnages have been divided by 22. This reflects the assumption that bulker lorries, with an average load of 22 tonnes, will be used to transport materials to reprocessing facilities. Estimated distances were multiplied by numbers of lorry movements to establish the road transport requirements of transporting materials to reprocessors, expressed in tonne-kilometres.

*Results*

The performance of each of the options is shown in *Table 1.12*, expressed in total tonne-kilometres travelled over the assessment period, 2005/6 to 2024/25.

*Table 1.12 Road Transportation Scores (Tonne-Kilometres)*

| Option | Total Tonne-Kilometres Travelled | Rank (1 = best performing) |
|---|---|---|
| **A** | 25,119,804 | **7** |
| **B** | 39,402,036 | **15** |
| **C** | 24,578,199 | **5** |
| **D** | 27,244,432 | **12** |
| **E** | 27,692,476 | **13** |
| **F** | 22,889,989 | **2** |
| **G** | 26,718,590 | **10** |
| **H** | 24,026,930 | **4** |
| **I** | 25,417,650 | **8** |
| **J** | 27,182,806 | **11** |
| **K** | 22,888,674 | **1** |
| **L** | 22,945,054 | **3** |
| **M** | 29,277,536 | **14** |
| **N** | 24,711,943 | **6** |
| **O** | 26,414,971 | **9** |

The options collecting increased quantities of material for recycling, specifically when they require reprocessing outside of Kent, have the greatest transport impacts. Options involving plastic recycling perform poorly due to the material need to travel to the north of England for reprocessing.

### *1.5.9 Financial Costs*

*Kerbside Recycling and Composting Options*

The Kerbside Analysis Tool (KAT), in the form of a Microsoft © Excel™ workbook, was used to calculate costs for this assessment. Costs were calculated for four 'standardised' Kent Districts in order to provide a guideline cost for kerbside collections. Full details of each group, as well as the methodology and assumptions used can be found in Annex B.

Option A has the lowest costs as the increase in participation and capture in this option can be accommodated by existing collection rounds. Option B sees the expansion of the current recycling scheme to all households in the District. Although there is a slight decrease in refuse costs, this does not offset the additional expenditure required to expand the recycling collections.

The options that require additional vehicles naturally see increases in the overall costs and costs per tonne collected. A weekly collection of compostable kitchen waste is among the most expensive options per tonne collected. The high level of additional diversion achieved by this option does not offset its high cost. Fortnightly garden waste collections are better value for money due to the higher tonnages collected and lower frequency of collection.

The inclusion of additional dry recyclables with current recyclables, in Options F, G, H and J, did not have a significant impact on collection costs. Extra vehicles were not required as there was sufficient capacity in the existing recycling rounds.

The inclusion of kitchen waste with the garden waste collections in Option I did not affect the number of vehicles required for this collection, but did reduce the number of refuse vehicles required in all groups except Group A. Group D does not currently operate a garden waste collection. The high cost per tonne associated with this option compared to Option A for the same group is as a result of the development of a combined garden and kitchen waste collection across the entire District.

***Table 1.13*** ***Gross Collection Cost per Tonne (£)***

| Option | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | | | | | | | | | | |
| A | 33.80 | - | 38.86 | 44.24 | - | - | - | - | 36.40 | - |
| | (1) | | (3) | (4) | | | | | (2) | |
| B1 | 53.00 | 61.53 | 57.00 | 66.67 | 60.78 | 53.00 | 53.02 | 53.29 | 52.98 | 53.43 |
| | (2) | (9) | (7) | (10) | (8) | (2) | (4) | (5) | (1) | (6) |
| B2 | 37.02 | 50.25 | 54.18 | 49.02 | 46.29 | 37.00 | 38.75 | 38.75 | 36.99 | 38.75 |
| | (3) | (9) | (10) | (8) | (7) | (2) | (4) | (4) | (1) | (4) |
| D | 38.90 | 41.76 | - | 52.83 | 48.99 | 38.87 | - | 38.85 | 49.14 | 38.88 |
| | (4) | (5) | | (8) | (6) | (2) | | (1) | (7) | (3) |

The costs calculated by KAT analysis are standard costs and provide estimates for certain levels of service provision. The costs presented here are intended to act as a guideline to the selection of an option. Specific local conditions may have a significant effect on costs that cannot be modelled as part of this assessment.

*Bring and Household Waste Recycling Centre (HWRC) Options*

Kerbside collections of recycling are considered more convenient for most people than bring systems. However, it has been shown that a bring system can complement even successful kerbside collections (1). Options K through

(1) Tucker, P., and Speirs, D., 2002, Model Forecasts of Recycling Participation Rates and Material Capture rates for Possible Future Recycling Scenarios, report to the Cabinet Office Strategy Unit.

O, summarised in *Table 1.14,* were modelled to understand the impact of an increase in bring site tonnages and HWRC recycling rates.

The costs of these options must be considered separately to those presented above, as these options are assessed on a countywide basis as opposed to a District level.

***Table 1.14*** ***Bring and HWRC Options***

| Option | Description |
|---|---|
| Option K | Increase recycling at bring sites by 15%. |
| Option L | Increase recycling at bring sites by 20%. |
| Option M | Expand the range of bring sites to include dense and film plastics. |
| Option N | Increase recycling at the HWRCs to 60%. |
| Option O | Increase recycling at the HWRCs to 75%. |

*Bring Site Method*

The options involving increased recycling through bring and HWRCs are more difficult financially to appraise in detail. Bring site management has been estimated to cost £22 per tonne of material collected. The total tonnes of material collected by bring banks in Options K, L and M was totalled and the cost applied to these tonnages.

*Results*

As expected the increased tonnages collected in Options K, L and M result in greater costs. These results are summarised in *Table 1.15*.

***Table 1.15*** ***Bring Bank Recycling Costs***

| Option | Cost |
|---|---|
| A – J | 14,526,181 |
| K | 16,705,108 |
| L | 17,431,417 |
| M | 22,791,997 |

*HWRC Cost Method*

The costs for managing refuse and recycling collections at HWRCs was provided by Kent County Council (1) and are presented in *Table 1.16* and *Table 1.18*. The Landfill Tax was applied as of the timetable presented in *Table 1.17.*

(1) Baldock, P (2006). Kent County Council, via email.

*Table 1.16 Waste to Landfill Costs for HWRCs*

| Description | Cost per tonne |
|---|---|
| Site Management Costs | £8.42 |
| Haulage Fees | £10.22 |
| Average Disposal Gate Fee | £18.36 |

*Table 1.17 Landfill Tax Timetable*

| Year | Tax per tonne |
|---|---|
| 2005 | £18 |
| 2006 | £21 |
| 2007 | £24 |
| 2008 | £27 |
| 2009 | £30 |
| 2010 | £33 |
| 2011 - 25 | £35 |

*Table 1.18 Recycling at HWRC Costs*

| Description | Cost per tonne |
|---|---|
| Site Management Costs | £9.43 |
| Haulage Fees | £18.80 |
| Net Recycling Gate Fees | £8.10 |

The tonnes of waste and recycling collected each year were collated and the cost data applied.

*Results*

The cost results for managing waste at HWRCs in Options N and O are presented in *Table 1.19*. The greater site management and haulage costs associated with increasing levels of recycling are more than compensated for by the difference between disposal and recycling costs. As the level of recycling increases the overall costs of these options actually reduces.

*Table 1.19 HWRC Costs*

| Option | Cost per tonne |
|---|---|
| A – M | £55.56 |
| N | £49.63 |
| O | £44.56 |

### 1.5.10 *Employment Opportunities*

The increase in long and short-term employment opportunities created by the operation of waste management facilities is an important criterion in terms of benefits for the local community and the local economy. The number of jobs generated by a particular facility depends primarily on two factors:

- type of facility (ie type of waste treatment/disposal technology); and
- size of facility (ie annual waste treatment/disposal capacity).

*Methods and Assumptions Used*

Limited research has been carried out in this area and so data relating to employment at waste management facilities were sourced from a South West Regional Assembly (SWRA) 2003 report (1), carried out as part of 'Developing a Regional Waste Strategy for the South West'. This report included baseline information on employment opportunities created by large (ranging from 15 000 to 100 000 tonnes per annum) and small (ranging from 2500 to 50 000 tonnes per annum) waste management facilities including MRF, windrow composting, in-vessel composting and landfill.

The baseline information included data relating to the total number of jobs generated, shift work and working time per month by type of facility at a specific annual capacity. The total jobs generated were split into two categories: skilled workers (consisting of site managers, assistant managers and foremen); and unskilled workers (consisting of operatives). For each type of facility, the number of skilled and unskilled workers was scaled according to facility capacity (presented in *Annex C*).

The impact score for the employment opportunities criterion consists of an annual average of total jobs for each option. An option's score was based on the number of skilled and unskilled workers employed each operational year at the required type, number and size of facilities for that particular option.

For each type of facility within each option, the skilled and unskilled jobs required in each year of operation were summed and divided by the number of the years spanning the assessment.

*Results*

The employment opportunities results are presented in *Table 1.20*, expressed in term of average number of jobs required per year.

(1) SLR Consulting Limited (June 2003) SWRA BPEO Report, Appendixes 4 & 7.
http://www.southwest-ra.gov.uk/swra/downloads/ourwork/waste/downloads/BPEO/Phase4.pdf [09/11/04 @ 14:30]

*Table 1.20 Employment Opportunity Scores (Average Number of Jobs per Year)*

| Option | Average Number of Jobs/Year | Rank (1 = best performing) |
|---|---|---|
| **A** | 170.9 | **11** |
| **B** | 190.9 | **1** |
| **C** | 173.1 | **8** |
| **D** | 171.2 | **10** |
| **E** | 167.4 | **14** |
| **F** | 174.4 | **7** |
| **G** | 175.7 | **6** |
| **H** | 172.9 | **9** |
| **I** | 165.6 | **15** |
| **J** | 176.6 | **4** |
| **K** | 169.7 | **13** |
| **L** | 170.5 | **12** |
| **M** | 176.3 | **5** |
| **N** | 178.3 | **3** |
| **O** | 187.7 | **2** |

Results show options involving increased MRF and transfer station capacity requirements to perform well in terms of future employment opportunities. Accordingly, option B and the increased CA site recycling options, N and O, rank highly against this performance criterion.

Options D, E and I each involve significant collections of kitchen and garden waste, but these materials will be delivered directly to less labour-intensive composting sites for processing. The result is that these strategic options perform relatively less well against this criterion.

### *1.5.11 Compatibility with the Waste Hierarchy*

The waste hierarchy seeks to promote an integrated approach to waste management. It reflects the fact that the best option for dealing with waste is to reduce the amount created, followed by re-use, recycling and composting, energy recovery and, finally, disposal. The aim is to move up the hierarchy to ensure better environmental protection and to meet statutory targets. The first steps of the waste hierarchy – waste minimisation and reuse - have been considered separately in the Waste Minimisation Options Appraisal Report for Kent.

This criterion assesses the ability of each of the options to manage waste in accordance with the waste hierarchy and relates directly to the total tonnage of material recovered for recycling or composting. Therefore, those options providing increased tonnages for recycling and composting material perform best against this criterion. The performance of each of the options is shown in *Table 1.21*, expressed in total tonnes of material recovered for recycling or composting over the assessment period, 2005/6 to 2024/25.

***Table 1.21 Compatibility with Waste Hierarchy Results (Tonnes Recovered for Recycling or Composting)***

| **Option** | **Tonnes Recovered for Recycling/Composting** | **Rank (1 = best performing)** |
|---|---|---|
| **A** | 5,678,143 | **12** |
| **B** | 7,524,064 | **1** |
| **C** | 5,769,961 | **11** |
| **D** | 6,540,896 | **4** |
| **E** | 6,557,616 | **3** |
| **F** | 5,556,108 | **15** |
| **G** | 5,971,665 | **8** |
| **H** | 5,853,094 | **10** |
| **I** | 6,231,093 | **5** |
| **J** | 6,007,841 | **7** |
| **K** | 5,629,606 | **14** |
| **L** | 5,662,620 | **13** |
| **M** | 5,906,283 | **9** |
| **N** | 6,207,209 | **6** |
| **O** | 6,785,577 | **2** |

## *1.6 RELIABILITY OF DELIVERY & LIABILITY OF END PRODUCT*

The success of the options examined in this assessment is dependent on two pivotal factors – householder participation and the liability of the end product.

*Householder Participation*

Option A and B rely on a significant increase in householder participation and capture rates. The high rates may be difficult to achieve because of problems in engaging a sufficient proportion of the community in recycling and because it is difficult for recyclers to consistently separate a high enough proportion of the recyclable material in the waste stream. A more simple system, such as a broad range of recyclables collected from a single container, will be easier for householders to follow and result in higher participation rates. The addition of extra materials to recycling collections in options C to J can raise overall rates of capture and participation. The inclusion of plastic bottles in kerbside collections has lead to overall recovery increases of collected materials of 53% (1).

It has been reported that the maximum level of participation that can be realistically expected is between 80 and 84% (2). Those options that require less than 80% participation at the kerbside are therefore given a lower score which is considered better in this criterion.

However, increased recycling at bring banks may be difficult to achieve due to the accessibility of these services. The use of recycling banks requires greater effort from the householder and as a result may not achieve the same level of participation and capture as a kerbside scheme.

***Table 1.22 Points Attributed to Recycling and Composting Participation***

| Recycling and Composting Rates | Score |
|---|---|
| Reliance on Bring Systems | 5 |
| > 80% | 3 |
| < 80% | 1 |

***Table 1.23 Scoring of Recycling and Composting Participation Rates***

| Option | Score for Recycling / Composting |
|---|---|
| **A** | 3 |
| **B** | 3 |
| **C** | 1 |
| **D** | 1 |
| **E** | 1 |
| **F** | 1 |
| **G** | 1 |
| **H** | 1 |
| **I** | 1 |
| **J** | 1 |
| **K** | 5 |
| **L** | 5 |
| **M** | 5 |
| **N** | 5 |
| **O** | 5 |

(1) RECOUP, (2006). Why Is Plastics Recycling Important For Local Authorities?
(2) Tucker P & Speirs D, (2002). Model Forecasts of Recycling Participation Rates and Material Capture Rates for Possible Future Recycling Scenarios.

*Liability of End Product*

The availability of markets for recyclables and compost can have a considerable impact on the deliverability of each option. As greater quantities of recyclables are collected, the risk associated with finding an outlet for all of the material increases. A slump in the price of virgin materials can reduce the desirability of recycled materials in industry, leading to stock piles of dry recyclables or, in extreme circumstances, the landfilling of recyclable material. It is considered advisable that any expansion in County-wide recycling services is accompanied by an assessment of the available markets for the materials.

The liability of end product has been calculated from the total tonnages of material recycled and composted in each option. The tonnes of material sent for recycling and composting has been scaled down by a factor of one million to produce a score that is compatible with the scores for participation.

***Table 1.24 End Product Liability***

| Option | Tonnes Recovered for Recycling/Composting | Score for Recycling / Composting | Rank (1 = best performing) |
|---|---|---|---|
| **A** | 5,678,143 | 5.7 | 4 |
| **B** | 7,524,064 | 7.5 | 15 |
| **C** | 5,769,961 | 5.8 | 5 |
| **D** | 6,540,896 | 6.5 | 12 |
| **E** | 6,557,616 | 6.6 | 13 |
| **F** | 5,556,108 | 5.6 | 1 |
| **G** | 5,971,665 | 6.0 | 8 |
| **H** | 5,853,094 | 5.9 | 6 |
| **I** | 6,231,093 | 6.2 | 11 |
| **J** | 6,007,841 | 6.0 | 9 |
| **K** | 5,629,606 | 5.6 | 2 |
| **L** | 5,662,620 | 5.7 | 3 |
| **M** | 5,906,283 | 5.9 | 7 |
| **N** | 6,207,209 | 6.2 | 10 |
| **O** | 6,785,577 | 6.8 | 14 |

*Results*

The score for the Deliverability criterion has been calculated by summing the scores for Participation and End Product Liability in Table 1.23 and Table 1.24. Option F, the expansion of cardboard recycling, is ranked highest as there is little change to the current system or levels of participation and this option can be considered eminently deliverable.

An increase in recycling at bring banks and HWRCs scores poorly as the high level of effort required from the householder is considered difficult to encourage. The high levels of participation required in options A and B combined with the large quantities of recyclables recovered negatively affects the deliverability of these options.

*Table 1.25 Deliverability of Options*

| Option | Score for Recycling / Composting | Rank (1 = best performing) |
|---|---|---|
| **A** | 8.7 | 9 |
| **B** | 10.5 | 10 |
| **C** | 6.8 | 2 |
| **D** | 7.5 | 7 |
| **E** | 7.6 | 8 |
| **F** | 6.6 | 1 |
| **G** | 7.0 | 4 |
| **H** | 6.9 | 3 |
| **I** | 7.2 | 6 |
| **J** | 7.0 | 4 |
| **K** | 10.6 | 11 |
| **L** | 10.7 | 12 |
| **M** | 10.9 | 13 |
| **N** | 11.2 | 14 |
| **O** | 11.8 | 15 |

## 1.7 *ACCESSIBILITY OF SERVICES*

The collection of a wider range of materials or broadening the coverage of current recycling services at the kerbside increases the convenience and accessibility of recycling for householders and will improve the capture rate of materials. Options B through J provide additional kerbside services, thereby increasing the accessibility of recycling. Option M assumes that 361 plastics bring banks are installed throughout the County, mirroring the number of glass banks in the County.

*Table 1.26 Accessibility of Services*

| Option | Additional Material / Households |
|---|---|
| A | - |
| B | 65 961 Households |
| C | Glass |

| Option | Additional Material / Households |
|---|---|
| D | Compostable Kitchen Waste |
| E | Garden Waste |
| F | Cardboard |
| G | Dense and Film Plastics |
| H | Aluminium and Steel Cans |
| I | Compostable Kitchen Waste and Cardboard |
| J | Cans and Plastics |
| K | - |
| L | - |
| M | Plastic Bring Banks |
| N | - |
| O | - |

This criterion has been scored by summing the coverage of recyclable materials collected at the kerbside across the County by option. In addition, the number of materials collected at bring banks has also been scored. Each type of bring bank provided has been given a score of five.

*Table 1.27* *Coverage of Recycling Services across Kent*

| Option | Paper | Card | Tins | Glass | Plastics | Kitchen Waste | Garden Waste | Bring Banks | Score |
|---|---|---|---|---|---|---|---|---|---|
| A | 92% | 67% | 56% | 17% | 33% | 0% | 41% | 45% | 351% |
| B | 100% | 100% | 100% | 100% | 100% | 0% | 100% | 45% | 645% |
| C | 92% | 67% | 56% | 100% | 33% | 0% | 41% | 45% | 434% |
| D | 92% | 67% | 56% | 17% | 33% | 100% | 41% | 45% | 451% |
| E | 92% | 100% | 56% | 17% | 33% | 0% | 41% | 45% | 410% |
| F | 92% | 67% | 56% | 17% | 100% | 0% | 41% | 45% | 384% |
| G | 92% | 67% | 100% | 17% | 33% | 0% | 41% | 45% | 418% |
| H | 92% | 67% | 100% | 17% | 33% | 0% | 41% | 45% | 395% |
| I | 92% | 67% | 56% | 17% | 33% | 41% | 41% | 45% | 392% |
| J | 92% | 67% | 100% | 17% | 100% | 0% | 41% | 45% | 462% |
| K | 92% | 67% | 56% | 17% | 33% | 0% | 41% | 45% | 351% |
| L | 92% | 67% | 56% | 17% | 33% | 0% | 41% | 45% | 351% |
| M | 92% | 67% | 56% | 17% | 33% | 0% | 41% | 50% | 356% |
| N | 92% | 67% | 56% | 17% | 33% | 0% | 41% | 45% | 351% |
| O | 92% | 67% | 56% | 17% | 33% | 0% | 41% | 45% | 351% |

*Table 1.28* *Accessibility of Services*

| Option | Score for Recycling / Composting | Rank (1 = best performing) |
|---|---|---|
| **A** | 351 | 11 |
| **B** | 645 | 1 |
| **C** | 434 | 4 |
| **D** | 451 | 3 |
| **E** | 410 | 6 |
| **F** | 384 | 9 |
| **G** | 418 | 5 |
| **H** | 395 | 7 |
| **I** | 392 | 8 |
| **J** | 462 | 2 |
| **K** | 351 | 11 |
| **L** | 351 | 11 |
| **M** | 356 | 10 |
| **N** | 351 | 11 |
| **O** | 351 | 11 |

Those options that collect a greater range of materials from the doorstep from the greatest number of houses score highest. Option B, current kerbside coverage extended to 100%, scores the highest as all households in the County have a wide range of material collected from the doorstep. The introduction of other materials to the entire District has less of an impact because the coverage of other materials such as plastics is low.

Recycling at HWRCs and bring banks is less convenient and accessible for the average householder than setting materials out at the kerbside, and this is reflected in their low ranking against this criterion. Options K, L, N and O increased the level of recycling at these sites without expanding their number thereby not increasing the accessibility of these facilities. The introduction of plastics banks in Option M sees a modest increase in accessibility.

## *1.8* *LANDUSE IMPACTS*

Land is a finite and valuable resource. Different treatment and disposal technologies have a far greater impact on the amount of land required for waste management than collection strategies. A discussion of land use impacts at this juncture is not appropriate as it would pre-empt the residual section of this report.

| Criterion | | Option A | Option B | Option C | Option D | Option E | Option F | Option G | Option H | Option I | Option J | Option K | Option L | Option M | Option N | Option O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Depletion of resources (tonnes of crude oil equivalents)** | | | | | | | | | | | | | | | | |
| | Score | -1,370,784 | -1,954,915 | -1,185,431 | -1,119,840 | -1,113,608 | -1,092,690 | -1,438,716 | -1,264,630 | -1,169,487 | -1,532,121 | -1,151,713 | -1,160,974 | -1,775,430 | -1,235,689 | -1,331,218 |
| | Rank | (5) | (1) | (9) | (13) | (14) | (15) | (4) | (7) | (10) | (3) | (12) | (11) | (2) | (8) | (6) |
| | Value | 0.32 | 1.00 | 0.11 | 0.03 | 0.02 | 0.00 | 0.40 | 0.20 | 0.09 | 0.51 | 0.07 | 0.08 | 0.79 | 0.17 | 0.28 |
| **Air acidification (tonnes of sulphur dioxide)** | | | | | | | | | | | | | | | | |
| | Score | -16,190 | -20,137 | -14,655 | -14,057 | -14,025 | -13,965 | -15,540 | -16,128 | -14,588 | -17,070 | -14,442 | -14,561 | -16,382 | -15,300 | -16,339 |
| | Rank | (5) | (1) | (9) | (13) | (14) | (15) | (7) | (6) | (10) | (2) | (12) | (11) | (3) | (8) | (4) |
| | Value | 0.36 | 1.00 | 0.11 | 0.01 | 0.01 | 0.00 | 0.26 | 0.35 | 0.10 | 0.50 | 0.08 | 0.10 | 0.39 | 0.22 | 0.38 |
| **Greenhouse gas emissions (tonnes of carbon dioxide equivalents)** | | | | | | | | | | | | | | | | |
| | Score | -520,039 | -1,648,446 | -181,071 | -262,104 | -249,560 | 258 | -492,790 | -499,166 | -300,000 | -770,263 | -140,079 | -163,411 | -734,127 | -428,330 | -734,544 |
| | Rank | (5) | (1) | (12) | (10) | (11) | (15) | (7) | (6) | (9) | (2) | (14) | (13) | (4) | (8) | (3) |
| | Value | 0.32 | 1.00 | 0.11 | 0.16 | 0.15 | 0.00 | 0.30 | 0.30 | 0.18 | 0.47 | 0.09 | 0.10 | 0.45 | 0.26 | 0.45 |
| **Health impacts (tonnes of 1,4-DB equivalents)** | | | | | | | | | | | | | | | | |
| | Score | -3.95E+06 | -4.88E+06 | -2.83E+06 | -2.85E+06 | -2.84E+06 | -2.82E+06 | -3.07E+06 | -4.17E+06 | -3.07E+06 | -4.18E+06 | -2.84E+06 | -2.84E+06 | -2.83E+06 | -3.39E+06 | -3.88E+06 |
| | Rank | (4) | (1) | (14) | (9) | (11) | (15) | (8) | (3) | (7) | (2) | (12) | (10) | (13) | (6) | (5) |
| | Value | 0.55 | 1.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.12 | 0.65 | 0.12 | 0.66 | 0.01 | 0.01 | 0.01 | 0.28 | 0.51 |
| **Energy consumption (TJ)** | | | | | | | | | | | | | | | | |
| | Score | -66,265 | -96,078 | -56,466 | -53,784 | -53,445 | -53,844 | -70,625 | -60,229 | -55,984 | -74,856 | -55,133 | -55,573 | -89,426 | -58,975 | -63,386 |
| | Rank | (5) | (1) | (9) | (14) | (15) | (13) | (4) | (7) | (10) | (3) | (12) | (11) | (2) | (8) | (6) |
| | Value | 0.30 | 1.00 | 0.07 | 0.01 | 0.00 | 0.01 | 0.40 | 0.16 | 0.06 | 0.50 | 0.04 | 0.05 | 0.84 | 0.13 | 0.23 |
| **Total road kilometres (te-km)** | | | | | | | | | | | | | | | | |
| | Score | 25,119,804 | 39,402,036 | 24,578,199 | 27,244,432 | 27,692,476 | 22,889,989 | 26,718,590 | 24,026,930 | 25,417,650 | 27,182,806 | 22,888,674 | 22,945,054 | 29,277,536 | 24,711,943 | 26,414,971 |
| | Rank | (7) | (15) | (5) | (12) | (13) | (2) | (10) | (4) | (8) | (11) | (1) | (3) | (14) | (6) | (9) |
| | Value | 0.86 | 0.00 | 0.90 | 0.74 | 0.71 | 1.00 | 0.77 | 0.93 | 0.85 | 0.74 | 1.00 | 1.00 | 0.61 | 0.89 | 0.79 |
| **Employment opportunities (annual average no. of total jobs)** | | | | | | | | | | | | | | | | |
| | Score | 170.9 | 190.9 | 173.1 | 171.2 | 167.4 | 174.4 | 175.7 | 172.9 | 165.6 | 176.6 | 169.7 | 170.5 | 176.3 | 178.3 | 187.7 |
| | Rank | (11) | (1) | (8) | (10) | (14) | (7) | (6) | (9) | (15) | (4) | (13) | (12) | (5) | (3) | (2) |
| | Value | 0.21 | 1.00 | 0.29 | 0.22 | 0.07 | 0.35 | 0.40 | 0.29 | 0.00 | 0.43 | 0.16 | 0.19 | 0.42 | 0.50 | 0.87 |
| **Compliance with policy (tonnes recycled/composted)** | | | | | | | | | | | | | | | | |
| | Score | 5,678,143 | 7,524,064 | 5,769,961 | 6,540,896 | 6,557,616 | 5,556,108 | 5,971,665 | 5,853,094 | 6,231,093 | 6,007,841 | 5,629,606 | 5,662,620 | 5,906,283 | 6,207,209 | 6,785,577 |
| | Rank | (12) | (1) | (11) | (4) | (3) | (15) | (8) | (10) | (5) | (7) | (14) | (13) | (9) | (6) | (2) |
| | Value | 0.06 | 1.00 | 0.11 | 0.50 | 0.51 | 0.00 | 0.21 | 0.15 | 0.34 | 0.23 | 0.04 | 0.05 | 0.18 | 0.33 | 0.62 |
| **Liability of end product (tonnes recycled/composted)** | | | | | | | | | | | | | | | | |
| | Score | 5,678,143 | 7,524,064 | 5,769,961 | 6,540,896 | 6,557,616 | 5,556,108 | 5,971,665 | 5,853,094 | 6,231,093 | 6,007,841 | 5,629,606 | 5,662,620 | 5,906,283 | 6,207,209 | 6,785,577 |
| | Rank | (4) | (15) | (5) | (12) | (13) | (1) | (8) | (6) | (11) | (9) | (2) | (3) | (7) | (10) | (14) |
| | Value | 0.94 | 0.00 | 0.89 | 0.50 | 0.49 | 1.00 | 0.79 | 0.85 | 0.66 | 0.77 | 0.96 | 0.95 | 0.82 | 0.67 | 0.38 |
| **Deliverability & Risk** | | | | | | | | | | | | | | | | |
| | Score | 8.70 | 10.50 | 6.80 | 7.50 | 7.60 | 6.60 | 7.00 | 6.90 | 7.20 | 7.00 | 10.60 | 10.70 | 10.90 | 11.20 | 11.80 |
| | Rank | (9) | (10) | (2) | (7) | (8) | (1) | (4) | (3) | (6) | (4) | (11) | (12) | (13) | (14) | (15) |
| | Value | 0.60 | 0.25 | 0.96 | 0.83 | 0.81 | 1.00 | 0.92 | 0.94 | 0.88 | 0.92 | 0.23 | 0.21 | 0.17 | 0.12 | 0.00 |
| **Cost Group A (£/ton collected)** | | | | | | | | | | | | | | | | |
| | Score | £111.36 | - | £116.42 | £121.80 | - | - | - | - | £113.96 | - | £111.17 | £111.17 | £111.17 | £105.24 | £100.17 |
| | Rank | (6) | - | (8) | (9) | - | - | - | - | (7) | - | (3) | (3) | (3) | (2) | (1) |
| | Value | 0.48 | - | 0.25 | 0.00 | - | - | - | - | 0.36 | - | 0.49 | 0.49 | 0.49 | 0.77 | 1.00 |
| **Cost Group B1 (£/ton collected)** | | | | | | | | | | | | | | | | |
| | Score | £130.56 | £139.09 | £134.56 | £144.23 | £138.34 | £130.56 | £130.58 | £130.85 | £130.54 | £130.99 | £130.58 | £130.58 | £130.58 | £124.65 | £119.58 |
| | Rank | (4) | (14) | (12) | (15) | (13) | (4) | (6) | (10) | (3) | (11) | (6) | (6) | (6) | (2) | (1) |
| | Value | 0.55 | 0.21 | 0.39 | 0.00 | 0.24 | 0.55 | 0.55 | 0.54 | 0.56 | 0.54 | 0.55 | 0.55 | 0.55 | 0.79 | 1.00 |
| **Cost Group B2 (£/tonne collected)** | | | | | | | | | | | | | | | | |
| | Score | £114.58 | £127.81 | £131.74 | £126.58 | £123.85 | £114.56 | £116.31 | £116.31 | £114.55 | £116.31 | £114.57 | £114.57 | £114.57 | £108.64 | £103.57 |
| | Rank | (8) | (14) | (15) | (13) | (12) | (4) | (9) | (9) | (3) | (9) | (5) | (5) | (5) | (2) | (1) |
| | Value | 0.61 | 0.14 | 0.00 | 0.18 | 0.28 | 0.61 | 0.55 | 0.55 | 0.61 | 0.55 | 0.61 | 0.61 | 0.61 | 0.82 | 1.00 |
| **Cost Group D (£/tonne collected)** | | | | | | | | | | | | | | | | |
| | Score | £116.46 | £119.32 | - | £130.39 | £126.55 | £116.43 | - | £116.41 | £126.70 | £116.44 | 116.30 | 116.30 | 116.30 | 110.37 | 105.30 |
| | Rank | (9) | (10) | - | (13) | (11) | (7) | - | (6) | (12) | (8) | (3) | (3) | (3) | (2) | (1) |
| | Value | 0.56 | 0.44 | - | 0.00 | 0.15 | 0.56 | - | 0.56 | 0.15 | 0.56 | 0.56 | 0.56 | 0.56 | 0.80 | 1.00 |

*Recycling and Composting Options*

| Option | Description |
|---|---|
| Option A | Raise participation and capture rates of current recycling collections to 80% |
| Option B | Increase coverage of recycling and composting collections to 100% and increase participation and capture to 80%. |
| Option C | Expand glass collections to all households. |
| Option D | Introduce compostable kitchen waste collections to all households. |
| Option E | Expand garden waste collections to all relevant households. |
| Option F | Expand the current cardboard collections to all households. |
| Option G | Collect dense and film plastics from 100% of households. |
| Option H | Collect tins and cans from 100% of households. |
| Option I | Add kitchen and cardboard to current garden waste collections. |
| Option J | Collect commingled plastics and tins and cans from 100% of households. |
| Option K | Increase recycling at bring sites by 15%. |
| Option L | Increase recycling at bring sites by 20%. |
| Option M | Expand the range of bring sites to include dense and film plastics. |
| Option N | Increase recycling at the HWRCs to 60%. |
| Option O | Increase recycling at the HWRCs to 75%. |

**Key**

| | |
|---|---|
| Orange | Best Performing Option |
| Yellow | Second Best Performing Option |
| Light cyan | Next to Worst Performing Option |
| Light blue | Worst Performing Option |

Annex A

# Emission Factors

*Table A1.1 Impact Factors Used in Assessment*

| Activity | Coal Usage (kg) | Crude Oil Usage (kg) | Natural Gas Usage ($m^3$) | $SO_2$ Generation (g) | $CO_2$ Generation (g) | $CH_4$ Generation (g) | 1,4-Dichloro-benzene (kg) | Basis | Source |
|---|---|---|---|---|---|---|---|---|---|
| Grid Electricity | 0.24 | 0.006 | 0.074 | 1.62 | 590.4 | 2.07 | 0.0021 | per kWh generated | BUWAL 250[1] |
| Diesel Generation | 0.019 | 0.92 | 0.0026 | 2.30 | 421.68 | 3.70 | 0.66 | per litre generated | ETH[4] |
| Transportation (28 tonne truck) | 0.0012 | 0.055 | 0.0040 | 0.18 | 182 | 0.19 | 0.023 | per tonne-km | Ecoinvent v1.2[2] |
| Transportation (RCV) | 0.0094 | 0.37 | 0.019 | 1.67 | 1213 | 0.70 | 0.26 | per tonne-km | Ecoinvent v1.2[2] |
| | | | | | | | | | |
| *Material Recycling* | | | | | | | | | |
| Plastic | -0.011 | 0.78 | 1.032 | 6.12 | 1701 | 3.09 | 0.041 | per kg recycled | Idemat (2001)[3], BUWAL 250[1] |
| Glass | 0.091 | 0.20 | 0.0022 | 2.42 | 465 | 0.78 | 0.056 | per kg recycled | BUWAL 250[1] |
| Aluminium | 2.62 | 1.25 | 0.20 | 54.76 | 9070 | 20.25 | 40.37 | per kg recycled | ETH[4] |
| Ferrous | 1.008 | 0.063 | 0.0 | 3.32 | 1810 | 8.77 | 0.17 | per kg recycled | BUWAL 250[1] |
| Aggregate | 0.0011 | 0.0015 | 0.00059 | 0.021 | 8.46 | 0.011 | 0.0014 | per kg recycled | Idemat (2001)[3] |
| Paper | 0.04 | 0.083 | 0.0093 | 3.54 | 367 | 0.629 | 0.14 | per kg recycled | BUWAL 250[1] |
| Textiles | 0.28 | 0.75 | 1.1 | 16.3 | 2030 | 4.05 | 0.44 | per kg recycled | Idemat (2001)[3], BUWAL 250[1] |
| Garden Waste (fertiliser equivalent) | 0.0019 | 0.0043 | 0.011 | 0.082 | 37.1 | 0.073 | 0.020 | per kg composted | Ecoinvent v1.2[2] |
| Kitchen Waste (fertiliser equivalent) | 0.0025 | 0.0057 | 0.014 | 0.11 | 49.0 | 0.097 | 0.027 | per kg composted | Ecoinvent v1.2[2] |
| Wood | 0.021 | 0.032 | 0.010 | 0.51 | 179.4 | 0.24 | 0.087 | per kg recycled | Ecoinvent v1.2[2] |


References:

1. BUWAL 250, 2nd edition. Fully documented and licensed database. (http://www.pre.nl/download/manuals/DatabaseManualBUWAL250.pdf)
2. Frischknecht R., Jungbluth N., Althaus H.-J., Doka G., Heck T., Hellweg S., Hischier R., Nemecek T., Rebitzer G., Spielmann M. (2004) Overview and Methodology. Ecoinvent report No. 1. Swiss Centre for Life Cycle Inventories, Dübendorf, 2004 (http://www.ecoinvent.ch/download/01_OverviewAndMethodology.pdf)
3. Data collection from various sources supervised by Dr. Han Remmerswaal, Faculty of Industrial Design Engineering, Delft Technical University, The Netherlands
4. ETH-ESU. Licensed database. (http://www.pre.nl/download/manuals/DatabaseManualETH-ESU96.pdf)

Annex B

# Kerbside Analysis Tool

# 1 KERBSIDE ANALYSIS TOOL

## 1.1 WHAT IS KAT?

The Kerbside Analysis Tool (KAT), in the form of a Microsoft © Excel™ workbook, enables projections of infrastructure requirements and associated costs for different kerbside recycling and composting collections ('kerbside collections') to be made for a local authority. The latest version of KAT can be downloaded for free from the WRAP website.

It can be used to:

- establish the infrastructure required for different collections;
- establish the relative costs of implementing different systems;
- assess and compare collection options to identify the most financially viable, by running different scenarios;
- compare the cost effectiveness of different scenarios (for example, decreasing capture, but increasing participation or coverage);
- assess costs submitted by contractors, to ensure proposals are realistic and provide value for money;
- plan the strategic implementation of kerbside collection systems; and
- assist in supporting funding bids by providing efficient and comprehensive options appraisal.

## 1.2 HOW KAT ESTIMATES COSTS

KAT estimates costs based on the infrastructure required for different collection options. The number and type of vehicles, crew levels and other factors such as fuel usage and maintenance are all used to build an estimate. The required infrastructure is heavily dependent on the types of material collected, the frequency of collection, and householder participation and set-out.

Other factors that influence the infrastructure are the choice of technology or collection method. The use of wheeled bins for refuse collection requires a bin lift on the collection vehicle and the emptying cycle takes more time than loading black refuse sacks. Local factors such as time taken to travel to landfill sites will also influence the infrastructure needed.

Standard costs are used to project the vehicle standing and operating costs. This enables direct comparisons between the relative costs of implementing different collection systems within a specific authority or groups of authorities.

## 1.3 *KAT PROJECTIONS*

The costs provided by KAT are standard costs and are only indicative figures. Some of the reasons for this are:

- KAT does not include any client or contract management costs;
- KAT takes no account of different financing options, eg vehicle lease or purchase;
- KAT takes no account of broader contracting terms, eg a contract covering more than household recycling;
- KAT cannot indicate if the performance is achievable, simply the cost if the desired performance is achieved;
- KAT takes no account of strategic reasons behind contractors wishing/not wishing to work in the area;
- KAT takes no account of possible bulk discounts from equipment manufacturers or service providers;
- the projections in KAT are based on a large number of assumptions, eg waste composition, household behaviour, timings for different activities etc, but contractors will base their bids on their own assumptions;
- KAT can by its nature consider only generic systems while an eventual system and contract will require a much more detailed specification;
- KAT takes no account of specific local requirements, for example the need for special vehicles for restricted access areas;
- KAT takes no account of the burden of risk to be carried by the WCA and the contractor;
- KAT takes no account of spare vehicles or additional smaller vehicles required for the delivery of containers or to collect missed material; and
- in calculating the total system cost, KAT assumes that savings in refuse collection and disposal are possible.

## 2 KAT ANALYSIS

### 2.1 INTRODUCTION

KAT has been used in this assessment to provide indicative costs for a range of options. Kent is composed of twelve District Councils all of which provide different refuse and recycling services. These were placed in four groups according to the similarities of their collection services. The purpose of these groupings is to provide guidance to each authority on the different level of costs associated with each option relative to their current service profile. The ordering of these groups is in no way associated with a ranking of any kind by ERM or the Kent Waste Partnership.

***Group A***

- The WCA has a district-wide green waste collection, a dry recyclables collection, and alternate weekly collection of refuse.
- The green waste collection may be free, charged or opt in, and this may limit the take up, but it is available to all.
- The WCA collects two or more dry recyclables at the kerbside (but not necessarily including glass).
- It has a relatively low population density.
- It could possibly improve performance by focusing on materials such as glass and kitchen waste, and / or on participation rates.

***Group B1***

- The WCA has a dry recyclables collection and weekly refuse collection with a well established wheeled bin system.
- It is experimenting with green waste collection using wheeled bins and a significant part of the district is covered.
- It does not collect a full range of materials at the kerbside.
- The WCA could achieve higher recycling through full roll out of the schemes, as well as by the measures above (in A). Locally, measures suited to higher density housing may be required

***Group B2***

- The WCA has a dry recyclables and weekly refuse collection service, using sacks or wheeled bins.
- It is experimenting with green waste collections in a limited way, and not necessarily using wheeled bins.
- Its capital expenditure in moving to a full wheeled bin system for refuse and green streams would be considerable.

- However, it could achieve higher recycling through full roll out of the schemes, as well as by the measures above (in A). Locally, measures suited to higher density housing may be required

*Group D*

- Has a weekly refuse collection and a kerbside dry recyclables collection but no green waste collection.
- Though it may collect 4 or more dry recyclables, there is a high potential tonnage of compostable material not captured.
- This category includes both high and low population density districts.
- These authorities can improve their composting rate (as opposed to diversion rate) by considering a green waste collection (with or without kitchen waste), provided there are suitable facilities.

## 2.2 *KAT OPTIONS*

The options assessed are presented in *Table 2.1.*

***Table 2.1 Options Assessed using KAT***

| Option | Description |
|---|---|
| A | Current Scheme: 80% Participation 80% Capture |
| B | Current Scheme: 100% Coverage, 60% Participation, 60% Capture |
| C | Glass separate collection |
| D | Kitchen waste (compostable) separate collection |
| E | Green waste collection |
| F | Cardboard |
| G | Plastic – bottles, dense plastic and film plastic |
| H | Tins and Cans |
| I | Add kitchen and card to existing green waste collections |
| J | Collect co-mingled cans and plastic |

The baseline data for this report was provided by four District Councils in Kent with varying levels of recycling provision.

The costs presented in this section are gross collection costs. They do not include the income a District Council may earn from selling recyclate or receiving recycling credits. The costs are also independent of disposal, treatment and sorting costs. Further assumptions on the various options are described in *Section 3.2*.

## 2.3 *Group A*

### *Baseline*

Group A's baseline includes a district-wide co-mingled dry recyclables collection (Kerbside 1); a green waste collection (Kerbside 2); and an alternate week refuse collection. The green waste collection includes all compostable garden waste but not kitchen waste. It is collected in 240l wheeled bins by a standard refuse collection vehicle. Another set of collection vehicles collect paper, cardboard, aluminium and steel cans and dense and film plastics co-mingled in council-issued plastic sacks for recycling. These materials are collected by a standard refuse vehicle. Refuse is collected fortnightly in 240l refuse bins.

A total of ten vehicles are used by the refuse and dry recycling collections. The refuse and recycling collections are allotted 5 and 4 permanent vehicles respectively. A further vehicle is shared on an alternate week basis.

*Table 2.2* ***Group A - Baseline Data***

| **Description** | **Data** |
|---|---|
| No. of Households | 60,000 |
| Estimated Average Participation | 70% |
| Coverage of Recycling Collections | 100% |
| Tonnes of Refuse Collected | 39,464 |
| Tonnes of Garden Waste Collected | 8,740 |
| Tonnes of Dry Recycling Collected | 10,392 |

### *Modelled Options*

Option B is not assessed in this grouping as the baseline recycling collections already cover all of the properties in the district. Options E to G and J are not included in this assessment as the additional materials collected in these scenarios are already collected in the baseline.

The quantity of material collected for recycling and composting in Option A increased by 4.4% over the baseline. Extra vehicles are not required to collect the additional material caused by a rise in participation and capture. Therefore, the cost of collection does not increase significantly from the baseline as can be seen in *Table 2.3*. The extra quantity of recyclables collected does not affect the number of vehicles required for refuse collection. However, there is a slight reduction in the number of loads collected by the refuse crews. This is mirrored across all the collection options except Option I.

Option C maintains the baseline rate of recycling and composting, but includes a separate glass collection (Kerbside 3) across the entire district with participation and capture rates of 60%. It is collected in an 8 tonne refuse vehicle, without compaction and is not sorted by colour. The vehicle is manned by one driver and one loader.

Option D incorporates a weekly compostable kitchen waste collection to 100% of households by a 4.5m$^3$ electric vehicle staffed by one driver and one loader (Kerbside 3). Five such vehicles are required to cover the district each collecting from 1,439 households each day.

Option I mixes the current garden waste collection with cardboard and compostable kitchen waste. Garden waste is held at baseline levels and the capture and participation rates for kitchen and cardboard are set at 60%. The additional material collected by the green waste vehicles requires an additional 1.5 vehicles. The half vehicle is shared with the dry recycling collection on an alternate week basis. The refuse is collected by five vehicles with the same number of loads as the Baseline. However, the number of households passed by the refuse crews per day increases from 1,033 to 1,129.

*Table 2.3* *Group A - Total Annual Gross Collection Costs (£)*

| Option | Kerbside 1 | Kerbside 2 | Kerbside 3 | Refuse | Total | Kerbside Recycling Increase (%) |
|---|---|---|---|---|---|---|
| Baseline | £598,092 | £546,837 | - | £824,665 | £1,969,593 | - |
| A | £598,096 | £546,837 | - | £824,546 | £1,969,571 | 4.40 |
| B | - | - | - | - | - | - |
| C | £598,092 | £546,837 | £306,717 | £824,555 | £2,276,200 | 3.03 |
| D | £598,092 | £546,837 | £621,327 | £824,530 | £2,590,785 | 4.36 |
| E | - | - | - | - | - | - |
| F | - | - | - | - | - | - |
| G | - | - | - | - | - | - |
| H | - | - | - | - | - | - |
| I | £598,132 | £714,897 | - | £807,770 | £2,120,799 | 4.97 |
| J | - | - | - | - | - | - |

### *Cost Benefit Analysis of Options*

The greatest increase in recycling/composting rate is achieved by Option I – combined fortnightly garden, compostable kitchen waste and cardboard. An increase in cardboard capture in this scenario has elevated it above Option D. By using already available vehicles to collect the additional material, costs are kept at a minimum. However, it is evident from *Table 2.4* that similar increases in recycling can be achieved by increasing participation and capture rates of currently collected materials. There is sufficient capacity within the current recycling rounds for this increase to be accommodated without using additional vehicles. In order to achieve such high levels of recycling, a comprehensive education campaign would be required. The cost of such a campaign cannot be accounted for by KAT but may be significant.

***Table 2.4*** ***Group A - Cost Benefit Analysis of Options***

| Option | Additional Annual Cost over Baseline | Percentage Recycling Increase | Additional Annual Cost per Percent Increase |
|---|---|---|---|
| A | - | 4.40% | - |
| C | £376,607 | 3.03% | £101,190 |
| D | £621,192 | 4.36% | £142,475 |
| I | £151,206 | 4.97% | £30,424 |

## *2.4 GROUP B1*

### *Baseline*

The Baseline of Group B incorporates three recycling collections. Kerbside A is a fortnightly collection of garden waste from approximately 50% of households. Kerbside 2 is a fortnightly collection of paper from 82% of households. Four vehicles are used for the garden waste collection. These vehicles are shared with the paper collection rounds. The vehicle costs for Kerbside 1 are accounted for under Kerbside 2. The cost estimated for Kerbside 1 relates to the supply of containers. An additional vehicle is also used to collect from the extra properties that receive a paper collection.

Glass is collected from approximately 24% of households in the district on a fortnightly basis. One vehicle manned by one driver and one loader services these properties. There are twelve refuse vehicles in operation collecting general refuse, in the baseline.

***Table 2.5*** ***Group B1 Baseline Data***

| Description | Data |
|---|---|
| No. of Households | |
| | 57,820 |
| Estimated Average Participation | 73% |
| Tonnes of Refuse Collected | 47,689 |
| Tonnes of Garden Waste Collected | 4,102 |
| Tonnes of Dry Recycling Collected | 2,355 |

*Modelled Options*

The highest increase in recycling is achieved in Option B. This option sees the expansion of the paper, garden and glass collection services to the entire district. Both paper and glass collections are assumed to have 60% participation and capture rates. Garden collection tonnages are assumed to be equal to the Kent County average of 0.12 tonnes per household.

It has been assumed that the additional dry recyclables collected in Options F, G, H and J are co-mingled with the current paper collections. There is little effect on the overall cost of services as the materials are collected by the same vehicles and from the same containers as are already in use.

***Table 2.6*** ***Group B1 – Total Annual Gross Collection Costs (£)***

| Option | Kerbside 1 | Kerbside 2 | Kerbside 3 | Kerbside 4 | Refuse | Total | Kerbside Recycling Increase (%) |
|---|---|---|---|---|---|---|---|
| **Baseline** | £87,807 | £535,486 | £94,911 | - | £2,167,204 | £2,885,407 | - |
| **A** | £87,807 | £535,602 | £94,957 | - | £2,166,910 | £2,885,276 | 5.97% |
| **B** | £173,821 | £540,352 | £468,234 | - | £2,166,831 | £3,349,239 | 9.78% |
| **C** | £87,807 | £535,486 | £468,555 | - | £2,166,157 | £3,197,517 | 1.62% |
| **D** | £87,807 | £535,486 | £95,009 | £745,241 | £2,165,946 | £3,629,489 | 3.89% |
| **E** | £680,289 | £380,860 | £94,911 | - | £2,166,313 | £3,292,372 | 7.39% |
| **F** | £87,807 | £535,489 | £94,911 | - | £2,166,786 | £2,884,992 | 1.55% |
| **G** | £87,807 | £535,486 | £95,009 | - | £2,167,834 | £2,886,136 | 2.57% |
| **H** | £87,807 | £535,472 | £94,911 | - | £2,166,797 | £2,884,986 | 0.99% |
| **I** | £87,807 | £535,486 | £94,911 | - | £2,166,154 | £2,908,405 | 9.76% |
| **J** | £87,807 | £535,486 | £94,911 | - | £2,166,937 | £2,885,140 | 3.56% |

*Group B1 – Cost Benefit Analysis of Options*

The expansion of all three Kerbside schemes (Option B) produces the greatest impact on recycling rates. However, the greatest benefit from expanding these schemes is gained from the expansion of the garden waste collections. Options C and D have the highest costs per percentage increase. The collections of glass and kitchen waste in these options are modelled as separate collections. They require a new set of vehicles and crew. Combining kitchen waste with garden waste and cardboard in Option I is a more cost-effective collection. Increased composting costs as a result of mixing kitchen waste with garden waste may negate any savings made on the collection side.

*Table 2.7 Group B1 – Cost Benefit Analysis of Options*

| Option | Additional Annual Cost over Baseline | Percentage Recycling Increase | Additional Annual Cost per Percent Increase |
|---|---|---|---|
| **A** | - | 5.97% | - |
| **B** | £463,832 | 9.78% | £47,427 |
| **C** | £312,110 | 1.62% | £192,660 |
| **D** | £744,082 | 3.89% | £191,281 |
| **E** | £406,965 | 7.39% | £55,070 |
| **F** | - | 1.55% | - |
| **G** | £729 | 2.57% | - |
| **H** | - | 0.99% | - |
| **I** | £22,998 | 3.13% | £2,356 |
| **J** | - | 3.56% | - |

## 2.5 GROUP B2

### Baseline

The Baseline for Group B has a number of different kerbside collections operating across the district. A paper and cardboard collection (Kerbside 1) is available to 88% of households. The materials are collected by two refuse collection vehicles. Residents provide their own containers for this collection.

A private contractor operates a collection scheme covering a further 2,600 households (Kerbside 2). The householder is provided with two boxes for paper, card, tins and cans and glass. These items are sorted at the kerbside. Refuse is collected weekly and the majority of households do not have a garden waste collection.

There are 1,400 households on an alternate weekly collection. Refuse is collected in week one and dry recyclables (Kerbside 3) and garden waste (Kerbside 4) are collected in week two. The dry recyclables include paper, cardboard, tins and cans and dense and film plastics. They are collected co-mingled in council-issued clear plastic sacks by refuse collection vehicles. The same dry recyclables are collected from a further 2,100 households (Kerbside 3) but refuse is collected weekly and the garden waste collections do not extend to these households.

*Table 2.8 Group B2 - Baseline Data*

| Description | Data |
|---|---|
| No. of Households | 50,740 |
| Estimated Average Participation | 65% |
| Tonnes of Refuse Collected | 47,751 |
| Tonnes of Garden Waste Collected | 454 |
| Tonnes of Dry Recycling Collected | 3,100 |

***Modelled Options***

Kerbside collections 3 and 4 share vehicles with the refuse collections. The costs associated with the vehicles are therefore accounted for under the Refuse section, with only the container costs included in Kerbside 3 and 4.

As several different recycling collections are operating simultaneously the clear sack recycling scheme and garden waste collection services were chosen to cover 100% of the district in Option B. The high cost of this option is due to the continuation of weekly refuse collections.

Option I (current garden waste collections co-mingled with kitchen waste) results in a very low increase in recycling. The addition of extra materials to the Baseline garden waste collections has little overall effect as these collections cover only 3% of the district. The extra materials do raise the overall tonnage of the collections by 12%. This suggests that spread over an entire district this may have a significant effect as seen in Group A.

Cardboard is collected from almost 100% of households in the district. The participation and capture rates of cardboard in this option are assumed to be 60%. This results in an increase in the amount of cardboard collected as the baseline rates of participation and capture are less than 60%.

The additional costs associated with Kerbside 1 in Options G, H and J are related to containers. The resident provides their own container for the Baseline paper and cardboard collections in this group. As the range of materials expands in the above options, it is considered necessary for a container of some description to be provided. As the materials were collected on a co-mingled basis in a refuse collection vehicle, clear plastic sacks were considered the most appropriate container. Residents are issued sixty eight sacks per year in these options.

*Table 2.9* *Group B2 – Total Annual Gross Collection Costs (£)*

| Option | Kerbside 1 | Kerbside 2 | Kerbside 3 | Kerbside 4 | Kerbside 5 | Refuse | Total | Kerbside Recycling Increase (%) |
|---|---|---|---|---|---|---|---|---|
| Baseline | £232,164 | £98,585 | £2,730 | £4,480 | | £1,645,417 | £1,983,375 | - |
| A | £232,528 | £98,676 | £2,730 | £4,480 | | £1,644,921 | £1,983,366 | 8.4% |
| B | £451,871 | £595,728 | - | - | | £1,645,385 | £2,692,983 | 17.29% |
| C | £232,395 | £219,130 | £2,730 | £4,480 | | £1,645,139 | £2,103,874 | 2.55% |
| D | £232,395 | £98,585 | £2,730 | £4,480 | £644,395 | £1,644,444 | £2,627,518 | 4.22% |
| E | £232,395 | £98,585 | £2,730 | £501,633 | | £1,645,442 | £2,480,784 | 10.62% |
| F | £232,304 | £98,587 | £2,730 | £4,480 | | £1,644,632 | £1,982,733 | 1.5% |
| G | £325,522 | £98,585 | £2,730 | £4,480 | | £1,645,458 | £2,076,775 | 2.79% |
| H | £325,594 | £98,585 | £2,730 | £4,480 | | £1,645,097 | £2,076,485 | 1.14% |
| I | £232,395 | £98,585 | £2,730 | £4,480 | | £1,644,439 | £1,982,628 | 0.17% |
| J | £325,522 | £98,585 | £2,730 | £4,480 | | £1,645,356 | £2,076,673 | 3.83% |

*Group B2 – Cost Benefit Analysis of Options*

It is clear from *Table 2.10* that significant benefits can be gained from increasing participation and capture rates across the district. A general increase to 80% participation and 80% capture across the range of systems and materials results in an 8.4% increase in the rate of kerbside recycling. Even an increase in participation and capture of cardboard in Option F results in a 1.5% increase in kerbside recycling.

There is no additional logistical cost associated with this increase as there is spare capacity in the current recycling rounds. However, KAT does not model the necessary promotional and educational costs that would be associated with such an increase in participation and capture.

Option B has the highest Additional Annual Cost over Baseline but has the greatest effect on the rate of recycling. The costs associated with this option may be reduced by collecting refuse on an alternate week basis.

*Table 2.10* ***Group B2 – Cost Benefit Analysis of Options***

| Option | Additional Annual Cost over Baseline | Percentage Recycling Increase | Additional Annual Cost per Percent Increase |
|---|---|---|---|
| **A** | - | 8.4% | - |
| **B** | £709,608 | 17.29% | £41,042 |
| **C** | £120,499 | 2.55% | £47,255 |
| **D** | £644,143 | 4.22% | £152,641 |
| **E** | £497,409 | 10.62% | £46,837 |
| **F** | - | 1.5% | - |
| **G** | £93,400 | 2.79% | £33,477 |
| **H** | £93,110 | 1.14% | £81,675 |
| **I** | - | 0.17% | - |
| **J** | £93,298 | 3.83% | £24,360 |

## 2.6 *GROUP D*

### *Baseline*

Group D's baseline incorporates a weekly refuse collection of bags and a fortnightly dry recyclables collection from 78% of households. Green waste is not collected at the kerbside. The baseline dry recyclables collection includes paper, glass and tins and cans. These are separated at the kerb, but glass is not sorted by colour. Recyclables are collected from a council-issued box, but residents must provide their own bags for refuse collection.

*Table 2.11* ***Group D - Baseline Data***

| Description | Data |
|---|---|
| No. of Households | 48,500 |
| Estimated Average Participation | 40% |
| Coverage of Recycling Collections | 38,000 |
| Tonnes of Refuse Collected | 35,919 |
| Tonnes of Garden Waste Collected | 0 |
| Tonnes of Dry Recycling Collected | 2,569 |

### *Modelled Options*

Option C is not assessed in this grouping, as 78% of households have a glass collection available to them as part of a kerbside scheme. Option H, collection of tins and cans, is also not examined as these are currently collected as part of the baseline.

As in Group A, the effect of expanding the existing kerbside scheme has a negligible impact on the costs of refuse collection, because insufficient extra quantities of refuse are diverted to justify decreasing the number of refuse rounds.

Options E and I have the highest diversion rates – Option I adds compostable kitchen waste and cardboard to the garden waste collections modelled in Option E. The number of refuse vehicles also decreases by one in both options. The introduction of a kitchen waste collection in Option D is more expensive than the garden waste collection service because it is collected on a weekly basis.

*Table 2.12* *Group D - Total Annual Gross Collection Costs (£)*

| Option | Kerbside 1 | Kerbside 2 | Refuse | Total | Kerbside Recycling Increase (%) |
|---|---|---|---|---|---|
| **Baseline** | £348,072 | | £1,143,126 | £1,491,197 | - |
| **A** | £351,656 | | £1,143,126 | £1,494,782 | 7.99 |
| **B** | £463,027 | | £1,143,126 | £1,606,153 | 12.08 |
| **C** | N/ A | N/ A | N/ A | N/ A | N/ A |
| **D** | £348,265 | £633,732 | £1,143,909 | £2,028,741 | 4.37 |
| **E** | £352,384 | £518,331 | £1,000,652 | £1,871,366 | 15.13 |
| **F** | £352,384 | | £1,143,126 | £1,495,509 | 1.50 |
| **G** | £352,330 | | £1,143,126 | £1,495,456 | 2.49 |
| **H** | £352,090 | | £1,143,126 | £1,495,216 | 0.58 |
| **I** | £352,090 | £518,638 | £1,000,375 | £1,871,103 | 21.27 |
| **J** | £352,178 | | £1,143,126 | £1,495,303 | 3.07 |

### *Cost-Benefit Analysis of Options*

The Group D baseline is founded on a low participation rate for dry recyclables. Increasing participation and capture has a large positive effect on the level of recycling. The average number of loads carried per vehicle per day increases from 0.6 to 1.3. Additional vehicles are not required as there is sufficient capacity within the current recycling rounds to accommodate this increase in tonnages.

By expanding the range of dry recyclables collected at the kerbside, there are small increases in the recycling rate at low cost. The fleet of recycling vehicles remains the same size as there is spare capacity in the current recycling rounds due to low levels of participation. An increase in participation may increase the cost of these options as further capacity is required.

The Baseline scenario does not include a garden or kitchen waste collection. The bulk density of compostable kitchen waste in KAT is estimated to be 700 kg/m$^3$ and accounts for 12.1% by weight of the household bin. The addition of a kitchen waste collection has a greater impact on recycling rates than the dry recycling collections modelled. However, the cost of kitchen waste collections per percentage increase in recycling is significantly higher than the other options. Kitchen waste is collected weekly in compostable paper bags by a separate collection service. The annual cost of supplying these bags to the householder accounts for 35% of the cost of this service. An alternate collection container may make this option more cost effective.

*Table 2.13* *Group D – Cost Benefit Analysis of Options*

| Option | Additional Annual Cost over Baseline | Percentage Recycling Increase | Additional Annual Cost per Percent Increase |
|---|---|---|---|
| **Baseline** | - | - | - |
| **Option A** | £3,585 | 7.99 | £449 |
| **Option B** | £114,956 | 3.85 | £29,859 |
| **Option C** | - | - | - |
| **Option D** | £537,544 | 4.37 | £123,008 |
| **Option E** | £380,169 | 15.13 | £25,127 |
| **Option F** | £4,312 | 1.50 | £2,875 |
| **Option G** | £4,259 | 2.49 | £1,710 |
| **Option H** | - | - | - |
| **Option I** | £379,906 | 21.27 | £17,861 |
| **Option J** | £4,106 | 3.07 | £1,338 |

The inclusion of a garden waste collection service across 100% of households in Option E has a significant effect on the recycling rate. This option was modelled using the current set-out rates for dry recyclables of 40%, and participation capture rates of 60%. The garden waste was collected fortnightly by three refuse vehicles. On average, each vehicle collected 0.7 loads per day. The number of vehicles collecting refuse fell from eight to seven to offset some of the costs associated with a garden collection service.

However, what is more significant in cost terms is the variation in set out rates, where the total waste collected remains the same, but the number of households visited to collect that amount varies. A garden waste collection service with a higher set-out rate will require more vehicles as the time taken to collect the extra containers will affect the number of households a crew can visit in a day, even if the tonnages remain the same.

## 2.7 *GROUP COMPARISON*

A wide range of materials and methods of collection are in evidence in each group baseline. *Table 2.135* presents the gross collection costs associated with each option for each group.

*Table 2.14* presents the gross cost of collection per tonne of all materials (ie the collection system cost), in each option across all four groups. The low baseline cost per tonne associated with Group A is due to a high participation and capture rate of recycling collections. The number of refuse vehicles used to collect general refuse is significantly less in this group also. The collections also use a co-mingled plastic sack collection of dry recyclables that, despite a high container cost, does have cost efficiencies in terms of the number of households visited by each crew per day.

The low baseline costs in group B2 can be explained by the uncomplicated nature of the recycling collections in this group. A paper and card collection operates across 88% of the district, but the residents must provide their own containers, significantly driving down costs.

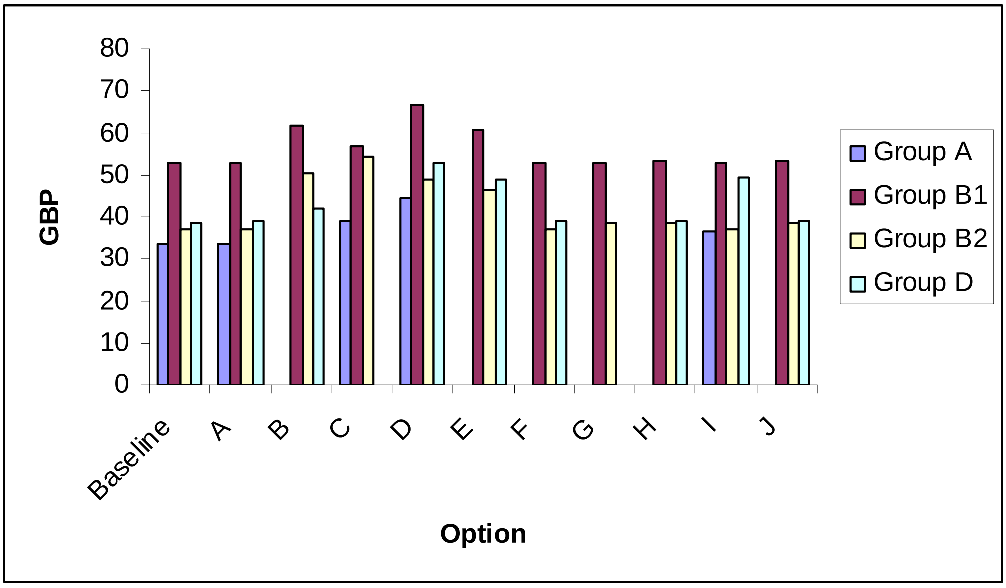
Group D has the lowest total cost of collection. However, the poor participation and capture rate of the current collections drives up the cost per tonne.

Group B1 has the highest total refuse cost and the highest cost per tonne collected. The relatively high numbers of refuse vehicles operating in this group elevate the costs. But these projections do not include the income gained from charging for garden waste collections.

***2.14 Gross Collection Cost per Tonne (£)***

| Option | Baseline | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | | | | | | | | | | | |
| A | 33.61 | 33.80 | - | 38.86 | 44.24 | - | - | - | - | 36.40 | - |
| B1 | 53.02 | 53.00 | 61.53 | 57.00 | 66.67 | 60.78 | 53.00 | 53.02 | 53.29 | 52.98 | 53.43 |
| B2 | 37.01 | 37.02 | 50.25 | 54.18 | 49.02 | 46.29 | 37.00 | 38.75 | 38.75 | 36.99 | 38.75 |
| D | 38.74 | 38.90 | 41.76 | - | 52.83 | 48.99 | 38.87 | - | 38.85 | 49.14 | 38.88 |

*Figure 2.1 Gross Collection Cost per Tonne*




There is sufficient spare capacity available within all recycling rounds to accommodate the increase in participation and capture in Option A without increasing costs.

The options that require additional vehicles naturally see increases in the overall costs and costs per tonne collected. A weekly collection of compostable kitchen waste is among the most expensive option per tonne collected. In terms of collection costs, the high level of additional diversion achieved by this option does not offset its high cost. Fortnightly garden waste collections are better value for money due to the higher tonnages collected.

The inclusion of additional dry recyclables co-mingled with current recyclables did not have a significant impact on collection costs except where additional containers were supplied. The costs associated with processing these additional materials at a MRF were not included in the KAT modelling.

The inclusion of kitchen waste with the garden waste collections in Option I did not affect the number of vehicles required for this collection and therefore lowered the cost per tonne.

As discussed in *Section 1.3*, the costs calculated by KAT analysis are standard costs and provide estimates for certain levels of service provision. The costs presented here are intended to act as a relative guideline to the selection of an option. Specific local conditions may have a significant effect on costs that cannot be modelled as part of this assessment.

*Table 2.15 Gross Collection Cost (£)*

| Option | Baseline | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | | | | | | | | | | | |
| A | £1,969,593 | £1,969,571 | - | £2,276,200 | £2,590,785 | - | - | - | - | £2,120,799 | - |
| B1 | £2,885,407 | £2,885,276 | £3,349,239 | £3,197,517 | £3,629,489 | £3,292,372 | £2,884,992 | £2,886,136 | £2,884,986 | £2,908,405 | £2,885,140 |
| B2 | £1,983,375 | £1,983,366 | £2,692,983 | £2,103,874 | £2,627,518 | £2,480,784 | £1,982,733 | £2,076,775 | £2,076,485 | £1,982,628 | £2,076,673 |
| D | £1,491,197 | £1,494,782 | £1,606,153 | - | £2,028,741 | £1,871,366 | £1,495,509 | £1,495,456 | £1,495,216 | £1,871,103 | £1,495,303 |

# 3 ASSUMPTIONS

## 3.1 GENERAL ASSUMPTIONS

Waste composition data was not provided for all groups. The Parfitt Composition [1] was therefore used for all four groups.

The proportion of dense to film plastics and aluminium to ferrous tins and cans were calculated according to the ratio provided by the Cleanaway MRF.

All recycling collections were made on a fortnightly basis unless otherwise stated.

All refuse collections were made on a weekly basis unless otherwise stated.

The depreciation period for all vehicles was assumed to be seven years.

Where information regarding costs was not available the KAT default is used in all instances.

## 3.2 OPTION ASSUMPTIONS

Option A assessed the affect of increasing capture and participation rates to 80%. Garden waste collections were assumed to operate at equal levels to the baseline.

Option B increased the coverage of existing recycling and composting collections to 100%. Participation and capture rates for dry recyclables were 60%. Where garden waste collection services were included the diversion is equal to 0.12 tonnes per household.

Option C introduced a fortnightly glass collection to the district. The residents were given a 40 – 60l box to store their glass.

Compostable kitchen waste was collected in paper bags on a weekly basis in Option D by a 4.5m$^3$ 1.2 tonne electric vehicle. Each household was given an annual allowance of sixty eight paper bags for kitchen waste.

Garden waste was collected in 240l wheeled bins from 100% of households in Option E. Although not all households would be capable of supporting a garden waste service, the tonnage of garden waste collected was calculated on a district-wide basis. The capture rate was assumed to be 0.12 tonnes per household per year. This had been calculated from the current garden waste

(1) Analysis of household waste composition and factors driving waste increases. Dr J Parfitt, 2002.

collection services operating in Kent. It was assumed that each household had one 240l wheeled bin for garden waste.

Options F, G and H see the addition of extra materials to existing kerbside collections. It was assumed that these materials are co-mingled with existing paper collections. Where materials are sorted at the kerbside, it was assumed that cardboard is co-mingled with paper and that the other items were collected separately. Existing boxes were used for the additional materials except in Group B, where a plastic sack was issued for the cans and plastics. Plastics were assumed to include plastic bottles, dense plastics and plastic film.

Option I expanded existing garden schemes to include cardboard and compostable kitchen waste. Material was collected on a fortnightly basis from a 240l wheeled bin. The vehicles used were the same size as the refuse trucks in the baseline.

Option J introduced a co-mingled plastic and cans collection. Existing containers were used for the additional materials except in Group B and D where a plastic sack was issued for the cans and plastics.

Annex C

# Employment Assumptions

## *C1 EMPLOYMENT ASSUMPTIONS*

### *Table 1.1 Employment*

| | Waste tonnage treated per annum | No of skilled | No of unskilled | Total number of workers |
|---|---|---|---|---|
| MRF/Transfer Station | 25 000 | 3 | 13 | 16 |
| | 50 000 | 3 | 20 | 23 |
| | 75 000 | 3 | 24 | 27 |
| | 100 000 | 6 | 27 | 33 |
| | 125 000 | 6 | 30 | 36 |
| | 150 000 | 6 | 32 | 38 |
| | 175 000 | 6 | 34 | 40 |
| | NB New shift needed per 100ktpa | | | |
| Windrow | 15 000 | 2 | 4 | 6 |
| | 30 000 | 2 | 6 | 8 |
| | 45 000 | 2 | 7 | 9 |
| In-Vessel Composting | 25 000 | 3 | 3 | 6 |
| | 50 000 | 3 | 5 | 8 |
| | 75 000 | 3 | 6 | 9 |
| Landfill | 100 000 | 3 | 4 | 7 |
| | 200 000 | 3 | 6 | 9 |

NB:
Skilled and Unskilled assume: site managers, assistant managers and foremen are skilled; and operatives/ weighbridge operators and machine operators are unskilled.
All figures above are taken from Appendix 4 SWRA BPEO Report June 2003
http://www.southwest-ra.gov.uk/swra/downloads/ourwork/waste/downloads/BEPO/Phase4.pdf