ITEM 9

Paper No. WRWA 21-14

WESTERN RIVERSIDE WASTE AUTHORITY

MEETING	29th June 2021
REPORT AUTHOR/DATE	CARBON METRIC REPORT *(Contact Mark Broxup - Tel. 020 8871 2788)* 21st June 2021
SUBJECT	Carbon Measurement Work carried out by Wood PLC.
CONTENTS	Page 1 Items Reported on Page 5 Recommendation Pages 6 to 97 Appendix A – Carbon Metric report, Wood PLC Pages 98 to 129 Appendix B - Presentation Slides – 16th June 2021 Pages 130 to 134 Appendix C – Comments/questions from Technical Officers
	Open
BACKGROUND PAPERS	None

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INTRODUCTION

1. Following Authority approval at the November 2019 Committee meeting (Paper No. WRWA 892) Wood PLC was appointed to carry out the carbon measurement work in May 2020, after consultation with the constituent councils. The specification requirement for this project was to provide baseline carbon footprint data for the Authority's operations over the last ten years and formulate some SMART carbon targets for the Authority and the Constituent Councils.

2. The final report has been distributed to the Members and Borough Technical Officers and is attached as Appendix A to this report. Wood gave a presentation to Members on 16th June 2021 to provide an overview of the work carried out. The presentation slides are attached as Appendix B for information.

3. WRATE was used to carry out the carbon measurement work. WRATE is a waste lifecycle assessment tool used to assess the environmental impacts of waste management activities. WRATE modelling calculates the actual lifecycle emissions of the materials based upon their end of life destinations and management approaches. The modelling has been undertaken using data primarily taken from WasteDataFlow (WDF) and supplemented by Authority provided data. From this base data modelling parameters were developed (e.g. recycling yields). Local and/or Authority-specific data used in preference to alternative data sources and/or default values to ensure the baseline model was as representative as possible.

4. Three of the four Borough Technical Officers have responded with comments and questions and these are attached with the Authority's responses as Appendix C to this report. A number of the questions will require additional bespoke modelling as they go beyond the remit of the original brief that Wood was commissioned to carry out. It is not proposed to undertake additional bespoke modelling that relates specifically to the Constituent Councils responsibility as they each have their individual strategic requirements.

5. The questions that concern Cory's operation, highlighted in Appendix C, have been sent to Cory requesting that they provide answers and, once a response is received, they will be forwarded to Technical Officers.

Carbon Impact

6. The graph below shows how the overall carbon impact of the Authority and its constituent councils has fallen dramatically since the turn of the century as a consequence of reduced waste arisings, increased recycling and residual waste going to Energy from Waste (**"EfW"**) rather than landfill. The increase between 2015 and

2019 is due to a model adjustment for the offset benefit from the EfW electricity production (for example as coal fired electricity generation reduced and renewable generation increased).



Key Performance Indicators and Options modelled

7. Informed by national, regional and local waste policy and strategy the impact of the Authority and its constituent councils managing their waste differently in the future was assessed and eight identified options were modelled:

    - Option 1: waste reduction per capita
    - Option 2: increase in dry recycling rate (includes all recyclable materials including textiles and WEEE but excludes food and garden waste)
    - Option 3: separate food waste collection to Anaerobic Digestion / In-Vessel-Composting vs Status Quo
    - Option 4: separate textiles collection
    - Option 5: reduction of packaging waste (Deposit Return Scheme assessment)
    - Option 6: low carbon transport options–
    - Option 7: alternate weekly collections (AWC)
    - Option 8: separate garden waste collection Vs the Status

8. The impact of these options being assessed against the following KPIs:

    - Recycling rate
    - Waste minimisation
    - Cost per tonne of waste managed
    - Vehicle Greenhouse Gas (GHG) emissions

- Total GHG emissions per household

Results

9. The results for the Authority are set out in Table 1, the full report also looks at each borough individually. To assist in highlighting and commenting on the results the following colour coding has been adopted – small improvement, large improvement, small disbenefit, large disbenefit.

Table 1

KPI	Baseline	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Recycling rate	25%	25%	38%	32%	26%	22%	-	27%	27%
Waste minimisation (against the baseline)	-	72,408t	-	-	-	22,216t	-	-	-
Cost / tonne of waste*	£178.27	-	-	£182.32	-	-	-	£171.06	£177.96
Vehicle GHG emissions (T)	3,394	3,388	4,046	4,048	3,392	3,391	763	2,095	3,403
Total GHG emissions per HH (KG/HH) and % improvement	-117.3 (basis)	-	-137.9 (17.8%)	-107.5 (-8.4%)	-113.4 (-3.3%)	-93.3 (-20.5%)	-123.1 (5.0%)	-120.6 (2.8%)	-115.8 (-1.3%)

*only calculated for options 3, 7 and 8

10. Option 1: waste reduction per capita – unfortunately WRATE is not effective at modelling waste minimisation, so the results have been excluded from the table. Waste minimisation is, however, recognised as being a better environmental option resulting in lower carbon impacts. Also, if modelled, it would result in the highest cost saving by a significant margin.

Option 2: increase in dry recycling rate - the modelled increase in dry recycling resulted in the highest potential increase in recycling rate, at 13 percentage points, and it also resulted in the largest decrease in total Green House Gas (**"GHG"**) emissions of nearly 18%.

Option 3: separate food waste collection to Anaerobic Digestion / In-Vessel-Composting vs Status Quo – this produced an increase of 7 percentage points in recycling rate, **but** was more expensive and resulted in an 8% increase in GHG emissions.

Option 4: Separate textiles collection – this had a marginal impact on the recycling rate as the tonnages are low, but in GHG emission terms the impact of the separate collection vehicles outweighed the benefits.

Option 5: Reduction of packaging waste (Deposit Return Scheme assessment) – this results in the Authority's recycling rate falling and, from the Authority's perspective,

an increase in GHG emissions. **However**, in this instance the benefits simply move away from the Authority to the DRS scheme. The DRS will not only capture material currently in the Authority's recycling stream, but should also capture material currently in the residual waste stream. Society as a whole would therefore benefit from the increased tonnage of material recycled overall and the reduction in GHG emissions as a consequence.

Option 6: Low carbon transport options – vehicle GHG emissions were based on diesel vehicles for all options, apart from option 6 which utilises electric vehicles. It was estimated that there would be a 38% reduction in vehicle GHG emissions, representing nearly a 3% reduction overall. The cost of this option was not modelled, but in the presentation to members Wood said that other projects they were involved with indicated that the lower fuel cost for electric vehicles could balance the additional upfront capital costs over the life of a fleet of vehicles, such that they were approaching being on a like for like basis in terms of cost with diesel vehicles.

Option 7: Alternate weekly collections (AWC) – this option was modelled for kerbside properties only and produced an overall cost saving of around 4%, a nearly 3% reduction in GHG emissions and a small increase of 2 percentage points in recycling rate.

Option 8: Separate Garden waste collection vs the Status Quo – this resulted in a small 2 percentage point increase in recycling rate (reflecting the high number of flatted properties in the Authority's area and the fact that some boroughs already operate paid for collection schemes). However, in terms of GHG emissions the result was a small increase in GHG emissions.

Baseline

11. All Options, including the baseline, include for the residual waste going by river to Cory's Riverside EfW Facility at Belvedere which currently utilises all the energy produced from the waste to generate electricity. As reported elsewhere on this agenda, Paper No. WRWA 21-14, the Government has recently awarded Cory £12.1 million in grants and loans to develop one of the UK's largest heat networks in the London Borough of Bexley.

12. Prior to this announcement Wood carried out a sensitivity analysis to identify the impact of introducing heat recovery at the EfW facility, based upon reducing the electricity generation by 5% to supply heat to a large industrial user offsetting mixed energy. This scenario would result in additional carbon savings of approximately 4,000Tpa for every 5% reduction in electricity production due to additional heat offtake.

13. Cory's scheme is that Riverside EfW facility will provide up to 30MW of heat for up to 10,500 homes in the London Borough of Bexley and the Royal Borough of Greenwich. 30MW represents around 45% of the EfW facility's output and, while supplying homes is unlikely to be as efficient as supplying a single large industrial user (due to increased transmission losses), it will still represent a very significant decrease in the current carbon emissions if constructed.

CONCLUSIONS

14. Whilst no hard and fast answers can be drawn from studies such as this it does highlight that what options may be good for one particular outcome, e.g. increasing weight based tonnage performance may not be the best in terms of other outcomes such as GHG emissions.

15. The detailed report also shows how, depended on their individual circumstances and waste composition, the impact of the different options can vary from borough to borough.

RECOMMENDATION

16. It is recommended that the Authority receives this report as information.

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21st June 2021

Western Riverside Waste Authority

Carbon Metric Project – Waste Management Activities

Final Report







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Document revisions

No.	Details	Date
P01	Draft interim report	05/01/2021
P02	Draft interim report – updated document	11/01/2021
P03	Draft report	22/02/2021
PO4	Final report	18/03/2021
P05	Final report (revised)	24/03/2021

Executive summary

Purpose of this report

This report has been prepared to present the findings of the project assessing the carbon impact of the Western Riverside Waste Authority's (the Authority) and its constituent Councils' waste management activities. The Authority is interested in the global warming impact of its activities, and a number of options have been modelled to determine what the Authority and its constituent Councils might focus on to best lessen any future impact.

Historical carbon emissions

The carbon impact of the services offered has been modelled using WRATE software for 2002, 2013 and 2019 to show the historic progression in carbon impact of the Authority's management of household waste. The figure below shows the changing carbon impacts at each point. In 2002 the Councils' recycling rates were very low, with residual waste being disposed of to landfill resulting in a very high carbon impact. By 2013 recycling services were becoming more established, with residual waste being treated at the Riverside EfW leading to reducing carbon emissions at the Authority level by approximately 120,000 tonnes per annum (tpa). The 2019 baseline position shows a slightly worse carbon emission position despite increased recycling rates due to the changing electricity offset benefit at the EfW, however the modelling suggests that this impact will be offset in the future due to the composition of waste entering the facility and the amount of dry recyclates collected.



Options identification

To identify how the Authority could further reduce their carbon emissions, a number of options were identified. The following waste management options were selected for modelling, as agreed with the Authority:

- Option 1: waste reduction per capita
- Option 2: increase in recycling rate
- Option 3: Separate food waste collection to AD/IVC vs status quo
- Option 4: Separate textiles collection

- Option 5: Reduction of packaging waste (DRS assessment)
- Option 6: Low carbon transport options
- Option 7: Alternate weekly collections (AWC)
- Option 8: Separate garden waste collection

Outcomes

The waste flow and carbon modelling, and resource and cost assessments illustrate to the Authority and the constituent Councils the impact that implementing the various options will have. A summary of results against the project KPIs are presented below. These are presented for the Authority as a whole but further breakdown is provided in the report. The recycling rate relates to household collected waste, with the average across all the Councils' household collected waste shown below. The Authority costs per tonne include the individual Council collection costs and the associated disposal costs.

KPI	Baseline	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Recycling rate	25%	25%	38%	32%	26%	22%	-	27%	27%
Waste minimisation (against the baseline)	-	72,408t	-	-	-	22,216t	-	-	-
Cost / tonne of waste*	£178.27	-	-	£182.32	-	-	-	£171.06	£177.96
Vehicle GHG emissions (T)	3,394	3,388	4,046	4,048	3,392	3,391	763	2,095	3,403
Total GHG emissions per HH (KG/HH) and % improvement	-117.3 (basis)	-	-137.9 (17.8%)	-107.5 (-8.4%)	-113.4 (-3.3%)	-93.3 (-20.5%)	-123.1 (5.0%)	-120.6 (2.8%)	-115.8 (-1.3%)

*only calculated for options 3, 7 and 8

All options apart from option 1 and 5 demonstrate increased recycling rates in comparison to the baseline. Options 2 and 3 in particular have the greatest impact on recycling rates. The inherent waste minimisation associated with option 1 and 5 has impacted the level of recycling achieved under these options.

The cost assessment for options 3, 7 and 8 has shown that option 3 is the most expensive option. This is largely due to the greater cost associated with running a food waste service such as the cost to run several additional vehicles. Implementing an alternate weekly collection service (AWC, option 7) is the least expensive option in comparison to the baseline.

Within the WRATE carbon results, the lower the number the better with negative numbers representing an overall comparative reduction in atmospheric carbon equivalent emissions. The results indicate that Option 2 leads to the lowest carbon impact with a decrease of almost 18%, with option 6 and option 7 also providing additional benefits. Options 3, 4, 5 and 8 result in an overall increase in carbon equivalent emissions with option 5 resulting in an increase of more than 20% as a result of recyclable materials (drinks packaging) being taken out of the constituent councils kerbside recycling waste stream. The environmental benefit will simply switch to the DRS scheme, but society will benefit overall from the additional materials DRS removes from the residual waste stream. The carbon impact of option 6 results in an approximate 75% reduction in

collection emissions. The figures under option 1 have not been included as the modelling software does not account for waste minimisation effectively.

The emissions breakdown associated with each of the options illustrates that the impact of recycling and waste treatment have the most significant impacts on waste service carbon emissions. It is important to emphasise that there are differences in the outcome of the different options across the constituent councils dependant on their waste composition and existing service provision. For example, whilst Option 3, the separate collection of Food Waste to Anaerobic Digestion (AD), results in an overall increase in atmospheric carbon equivalent emissions across the Authority's area, conversely in Lambeth, which sends organic waste to In-Vessel Composting (IVC), it would have a positive impact as AD treatment has a greater carbon benefit than IVC, due to the associated production of electricity.

Wood has devised a range of carbon management actions in section 6 of this report. For example, in option 3, the separate collection of Food Waste to Anaerobic Digestion (AD) results in an overall increase in atmospheric carbon equivalent emissions across the Authority area, conversely in Lambeth this is not the case who sends organic waste to In-vessel Composting (IVC). AD treatment of food waste has a greater carbon benefit than IVC due to the associated production of electricity, which is reflected in Lambeth's respective carbon emissions (Baseline IVC vs Option 3 AD). This will allow the Authority and Councils to work towards the goal of carbon reduction with guidance as to the input that will be required to implement the initiatives.

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Appendix B	Baseline Modelling
Appendix C	Options Identification
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1. Introduction

1.1.1 Wood has been commissioned by Western Riverside Waste Authority (the Authority) to assess the carbon impact of the Authority's and its constituent Councils' waste management activities. The output is intended to form part of a future new Joint Waste Policy and Strategy for the Authority and its constituent Councils (London Councils of Hammersmith and Fulham, Lambeth, Wandsworth and the Royal Borough of Kensington and Chelsea (RBKC)). The carbon impact of waste management activities within the Authority area, considering historic, current and future emissions, will be assessed. The work has taken into consideration the following three factors:

- Historic changes in the tonnage and composition of the Authority's waste over time and how tonnage and composition might change in the future;
- Changes in the way the Authority has managed its waste in the past and how it might do so in the future (e.g. the potential introduction of food and garden waste collections);
- Identification of which waste streams might be best targeted and how (e.g. reduction, reuse, recycling and recovery) to produce the greatest carbon savings taking into account other factors such as financial cost.

1.2 Purpose of report

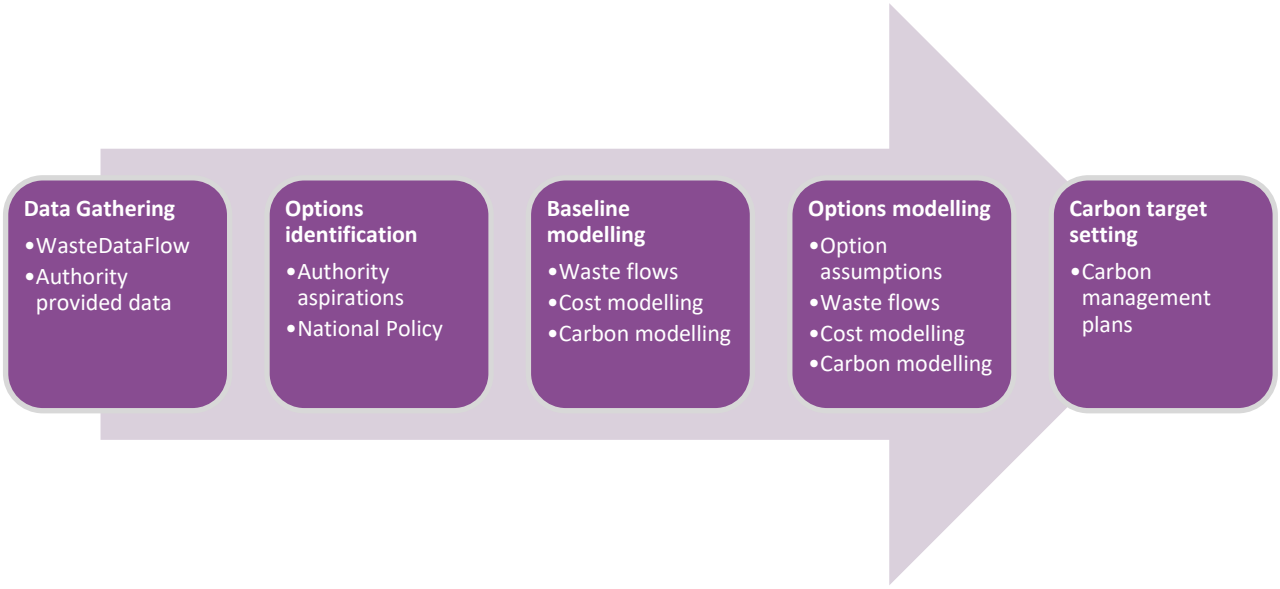
1.2.1 The purpose of the report is to assess the carbon impact of the Authority's waste management activities based on the following:

- historical trends;
- baseline waste flow modelling;
- options identification and modelling;
- resource and cost assessment;
- carbon modelling outputs; and
- carbon management plans.

2. Methodology

2.1.1 The approach to the project has consisted of a number of steps as identified in Figure 2.1. The sequential development of the project has relied on accurate data gathering to form a robust baseline model, and the options identification and assumptions have been formed through the direction of national policies, with input from both the Authority and Wood to finalise the assumptions in order to inform realistic output for future settings.

Figure 2.1 Project methodology



2.1.2 A number of Key Performance Indicators (KPIs) have also been proposed and agreed with the Authority to ensure that appropriate indicators have been deployed to monitor the impact of future waste management activities.

2.1.3 The steps followed in delivering this project are further discussed in the following sections of this report.

3. Key Performance Indicators

3.1.1 The development of appropriate KPIs will enable the Authority and constituent Councils to monitor and measure the effectiveness of any initiatives they implement to reduce carbon emissions, as well as to identify the potential impact on the performance of waste management operations. The KPIs developed are quantitative relating to service improvements.

3.1.2 The model has been designed in a way which allows the Authority to enter data from future waste composition analysis surveys. From this the Authority will be able to easily and readily obtain outputs and monitor progress towards meeting the waste flow related KPIs. The model is adaptable at the front end, with a bespoke output generator behind the model.

3.1.3 The KPIs were agreed with the Authority, taking into account contractual obligations as well as factors the Authority can influence over the contract period including the age of the collection fleet, fuel efficiency, and MRF reject rate. The following KPIs were agreed as being appropriate for the Authority to monitor:

- Recycling rate
- Waste minimisation
- Cost per tonne of waste managed
- Vehicle Greenhouse Gas (GHG) emissions
- Total GHG emissions per household

4. Waste data analysis

4.1 Introduction

4.1.1 The Authority provided Wood with waste data dating back to 2002. **Appendix A** considers the historical trends over the period 2002 to 2019, highlighting how the Authority's and individual Councils' waste arisings and management have changed over the years. Up until 2004, waste data was not recorded with the same granularity as it has been since, so this needs to be taken into consideration when interpretating the trends. Historical trends are provided for the Authority area as a whole, as well as for each of the constituent Councils. The historical data focuses on household and non-household waste collected at the kerbside and at HWRCs and excludes services that are collected outside these sources (e.g. street cleansing, waste from public areas, etc.).

4.1.2 A baseline model (details of which are in **Appendix B**) has been developed to support the assessment of KPIs on the three core areas of:

- Waste Flows;
- Service Costs; and
- Carbon Impact.

4.2 Baseline model summary outcomes

4.2.1 Following the baseline waste flow modelling and cost assessment, the recycling rate and cost per tonne of waste managed for the Authority and each individual Council can be found in Table 4.1. The recycling rate shown is for household collected waste, with the Authority's rate being the average across all the Councils household collected waste. The cost per tonne is the collection cost for the household collected waste and non-household collected waste service for kerbside residual waste and the household collected waste service for kerbside recycling. The Authority costs include the individual Council collection costs and the disposal costs.

Table 4.1 Baseline recycling rate and cost per tonne for the Authority and Councils

KPI	WRWA	H&F	RBKC	Lambeth	Wandsworth
Recycling rate	26%	25%	27%	32%	22%
Cost per tonne	£178.27	£50.82	£77.85	£41.80	£43.71

4.3 Carbon Impact

4.3.1 The carbon modelling was undertaken using the WRATE software; a tool for modelling the carbon and environmental impact of waste management services. WRATE allows the strategic evaluation of the environmental impact of waste management options, from collection through to treatment / disposal, supporting a comprehensive assessment of options.

4.3.2 The WRATE model has been developed to reflect the baseline flows for each of the individual Authorities (in 2030) which have been combined to calculate the impacts of the Authority as a whole. The model calculates the impacts of the containers, collection vehicles, intermediate facilities

(WTS & MRFs), recyclates and treatment and disposal elements to calculate an overall carbon impact expressed as a carbon dioxide equivalent. These figures are for the household collected waste.

4.3.3 The baseline total carbon impacts for the Authority and the constituent Councils are shown in Table 4.2. The nature of the WRATE software means that the assessment considers the whole life management of each constituent Council from collection to final use/disposal. Within the WRATE carbon results, the lower the number the better. The Authority figure is the total of the four constituent Councils.

4.3.4 The table shows that Wandsworth's baseline carbon position is better than the other constituent councils, in particular at the recycling level. The relative proportion of dry mixed recycling and the composition of the recycling tonnages Wandsworth collects, which includes a greater amount of plastics, aluminium and textiles, results in a better carbon benefit than organics recycling, which is reflected in the data.

Table 4.2 Baseline carbon emissions (Tpa) for the Authority and Councils

	WRWA	H&F	RBKC	Lambeth	Wandsworth
Containers	**1,740**	300	338	566	536
Waste Collection	**3,394**	368	1,067	932	1,027
WTS & MRF	**976**	176	157	245	399
Recycling	**-72,616**	-13,544	-11,286	-12,949	-34,838
Treatment (EfW/AD/IVC)	**3,955**	1,006	1,166	2,063	-279
Landfill	**24**	5	4	6	10
Total	**-62,526**	**-11,689**	**-8,554**	**-9,138**	**-33,145**
Households	**533,119**	**102,673**	**98,733**	**162,265**	**169,448**
KG CO_2/HH/Yr	**-117.3**	**-113.9**	**-86.6**	**-56.3**	**-195.6**

Historical carbon emissions

4.3.5 The carbon impact of the services offered has been modelled in 2002, 2013 and 2019 to show the historic progression in carbon impact of the Authority's waste management. Figure 4.1 shows the changing carbon impacts at each point. In 2002 the Council's recycling rates were very low and the residual waste was disposed of to landfill resulting in a very high carbon impact, by 2013 recycling was becoming more established and the residual waste was being treated at the Riverside EfW leading to reducing carbon emissions at Authority level by approximately 120,000 Tpa. The 2019 baseline position has a slightly worse carbon emissions despite increased recycling rates due to the changing electricity offset benefit at the EfW however the modelling suggests that this impact will be offset in the future due to the composition of waste entering the facility and the amount of dry recyclates collected.

Figure 4.1 Authority carbon impact for the baseline option (Tpa)



5. Options modelling

5.1 Options Identification

5.1.1 It is important the scenarios modelled align with the draft Environment Bill (2020) and associated draft Resources and Waste Strategy, currently under consultation; the Environment Bill builds on the government's decisive action to protect the environment, as set out in the 25 Year Environment Plan.

5.1.2 In developing the options, a review of policy documents was undertaken including the national Resources and Waste Strategy, The London Mayor's Environment Strategy and the respective local Council policies. **Appendix C** outlines the relevant policies and the focus and initiatives that have shaped the options agreed upon, noting that not all initiatives have been taken into account at the modelling stage due to uncertainties and lack of evidence and data to substantiate the approach. Some of the policies may become mandatory and/or may impact consumption patterns and products available to consumers, whereas some of the policies are non-statutory, local level aspirations and actions.

Options for modelling

5.1.3 In summary, the following waste management options were selected for modelling, as agreed with the Authority:

- Option 1: waste reduction per capita
- Option 2: increase in recycling rate
- Option 3: Separate food waste collection to AD/IVC vs Status Quo
- Option 4: Separate textiles collection
- Option 5: Reduction of packaging waste (Deposit Return Scheme (DRS) assessment)
- Option 6: Low carbon transport options
- Option 7: Alternate weekly collections (AWC)
- Option 8: Separate garden waste collection Vs the Status Quo

5.2 Options modelling approach

5.2.1 The options modelling task was split into two distinct parts:

- Waste flow modelling
- Resource and cost modelling

5.2.2 The waste flow modelling of the options has been completed for the constituent Councils and the Authority as a whole. The option waste flows have been developed by applying sets of assumptions on the calculated baseline flows. These assumptions are outlined in **Appendix D**.

5.2.3 It was agreed with the Authority that a high-level collections modelling exercise would be undertaken for options 3, 7 and 8, by averaging resources required across service delivery for

individual constituent Councils. No changes in resource requirements have been assumed for all other options.

5.2.4 Lambeth services have been modelled to show the collection of food and garden waste separately, as well as their current co-collection, to allow a comparison between both collection options.

5.2.5 Using the baseline waste flow model as a template, copies were made and the model inputs adjusted according to agreed assumptions for each option. The model allows full flexibility to modify any of the variables that affect waste flows. Where data has not been available, pre-agreed default values have been utilised.

5.3 Waste Flow Modelling Outputs

5.3.1 The following section provides the graphical outputs of the waste flow modelling for options 1-5 and 7-8. Option 6 does not result in a change in waste flows as it focusses on vehicle configuration. The outputs are presented for the Authority area as a whole and documents the trends in waste flow in line with the agreed assumptions.

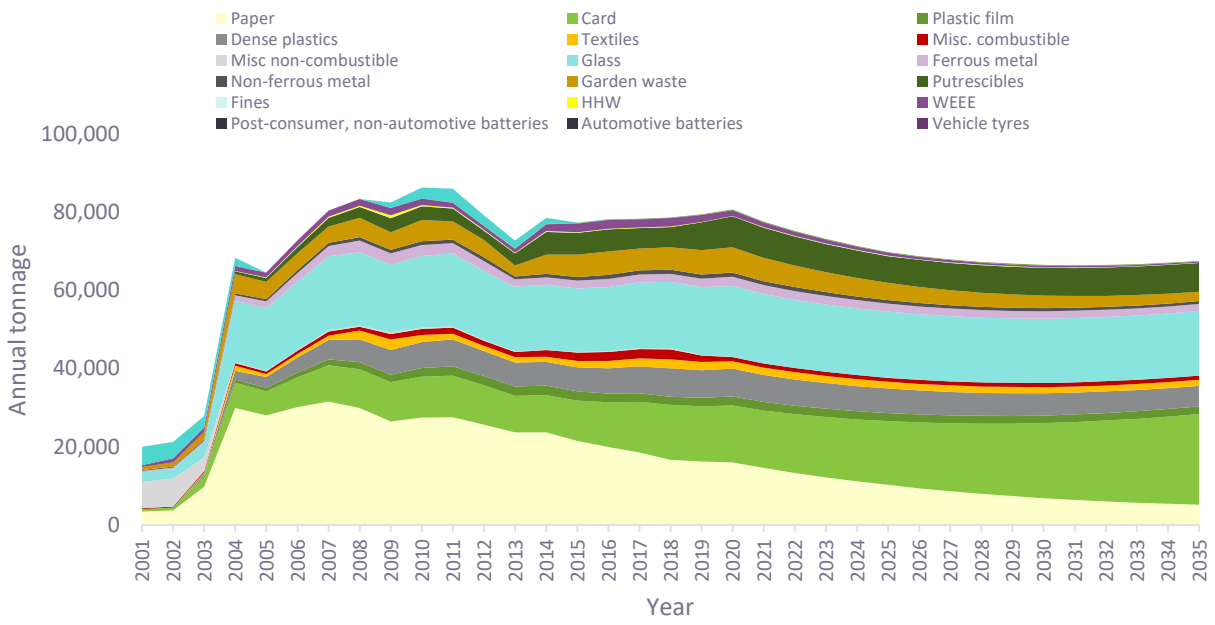
Option 1 Waste reduction per capita

5.3.2 The assumptions behind option 1, as detailed in appendix C, are as follows:

- The average trend of waste arisings (assumed reduction) over the last five years continues into the future
- 2019/20 yield/hh data was used as the starting point for the projections
- 20% reduction in food waste by 2025 using a 2015 baseline (Courtauld Commitment)
- Removal of single-use plastics (SUP) - 25% reduction in 'carrier bags', 'other non-packaging wrap and film' and 'polystyrene'; reduction achieved by 2030 and applied to the 2019 yields
- No reduction in PTTs; plastic appears to be the best material for the items contained in these, e.g. yoghurt, butter, dairy
- 20% of households sign up to the Mailing Preference Service (MPS) with an average reduction in 77% of unwanted mail by 2030.

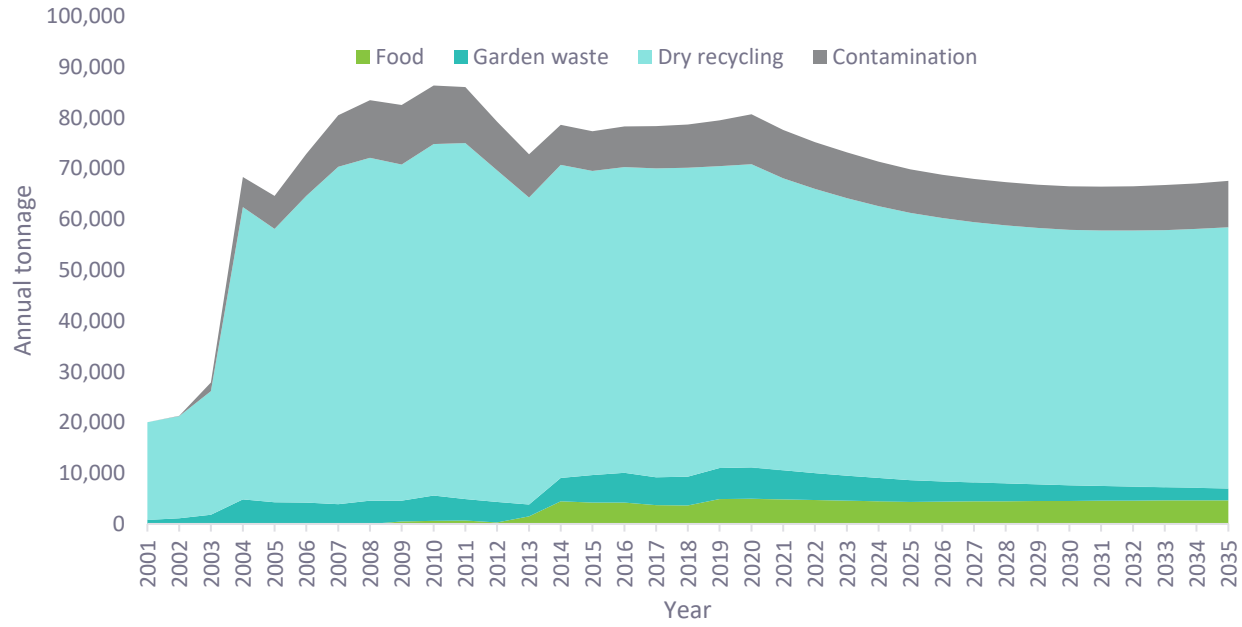
5.3.3 Figure 5.1 disaggregates the collected household recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.1 Option 1 - Total collected household recycling composition



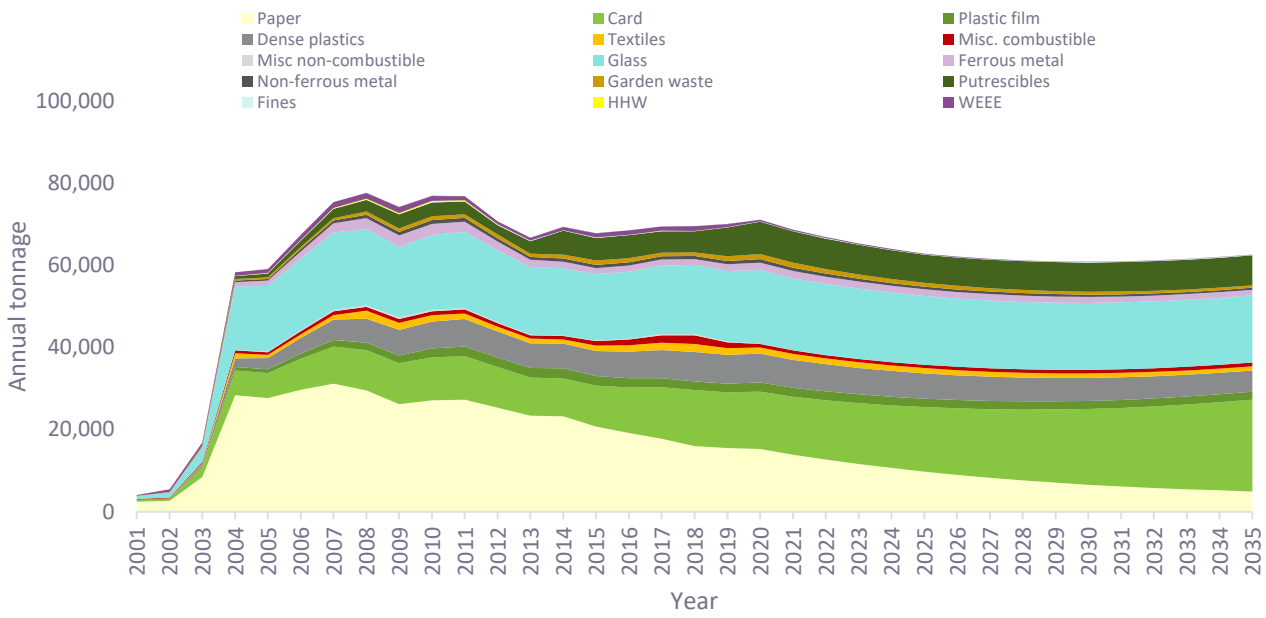
5.3.4 Figure 5.2 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.2 Option 1 - High level net household recycling composition



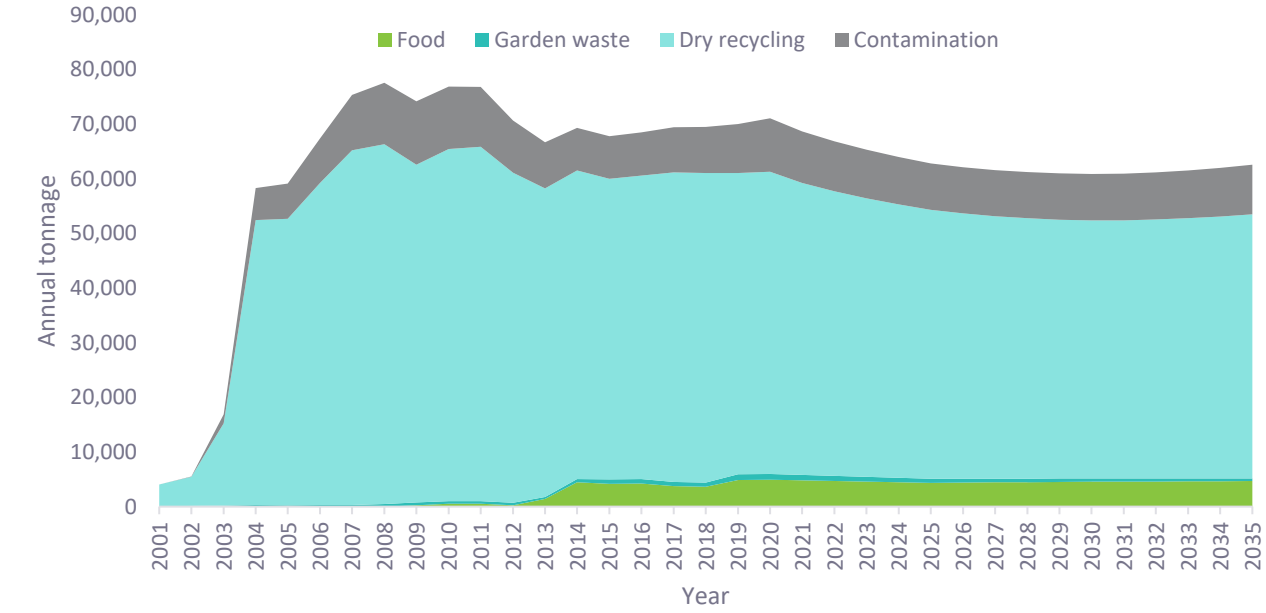
5.3.5 Figure 5.3 disaggregates the net kerbside household recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.3 Option 1 - Kerbside collected household recycling composition



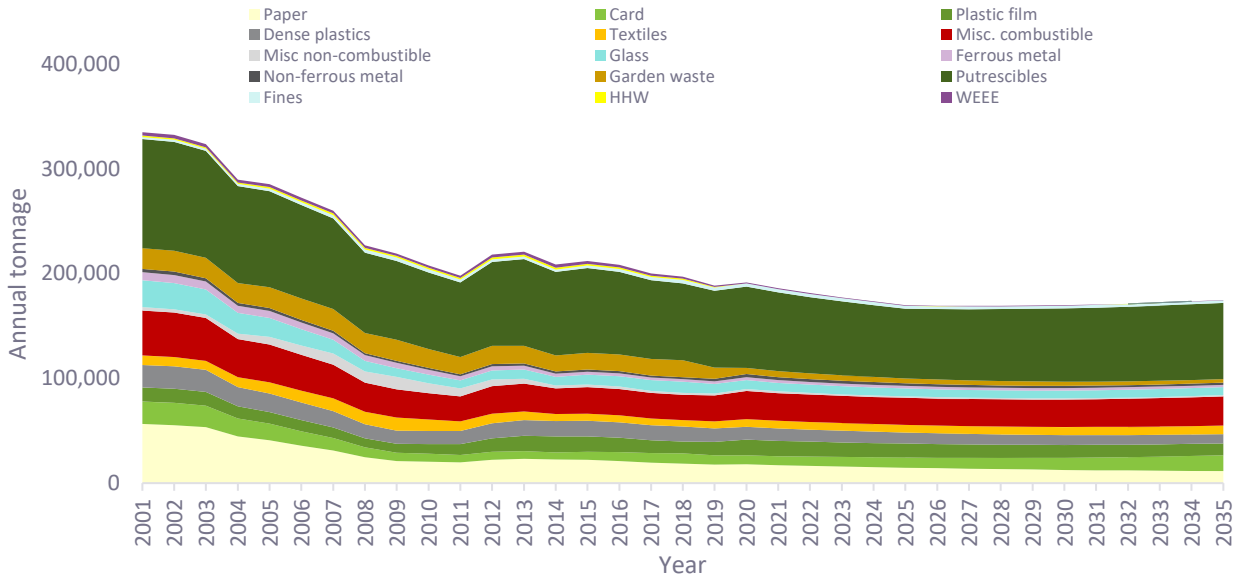
5.3.6 Figure 5.4 disaggregates the net kerbside recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.4 Option 1 - High level net kerbside recycling composition



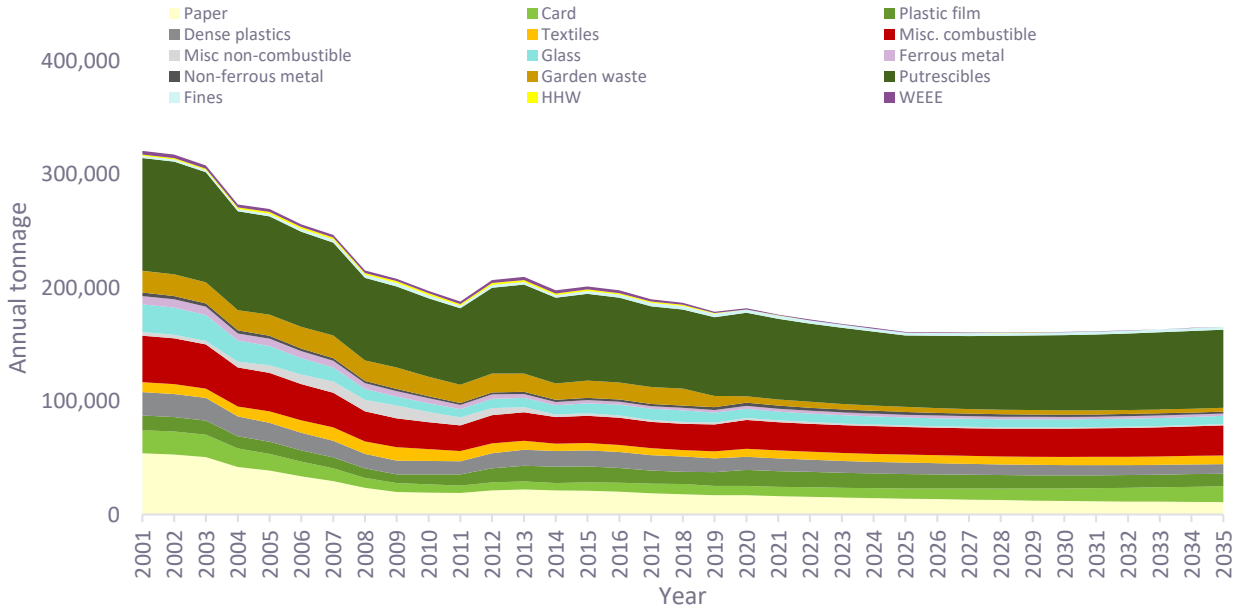
5.3.7 Figure 5.5 disaggregates the total collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.5 Option 1 - Total collected household residual waste composition



5.3.8 Figure 5.6 disaggregates the Kerbside collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.6 Option 1 - Kerbside collected residual waste composition



5.3.9 If the Authority and / or Councils were to implement the measures identified under option 1, the recycling rate and waste minimisation levels achieved would be as presented in Table 5.1.

Table 5.1 Option 1 recycling rate and waste minimisation for the Authority and Councils

KPI	WRWA	H&F	RBKC	Lambeth	Wandsworth
Recycling rate	25%	24%	22%	34%	19%
Waste minimisation against the baseline	72,408	19,984	7,057	22,249	22,937

5.3.10 For all Councils apart from Lambeth, the recycling rate decreases slightly in comparison to the baseline, more so for RBKC. Lambeth's recycling rate increases by approx. 2%. The waste minimisation achieved under this option for RBKC is also lower than that achieved by the other Councils. This is mainly due to differences in composition between the Councils; the reductions of targeted materials are based on percentages of current waste arisings, so authorities with higher waste arisings at present will result in the largest reductions. We have also assumed a factor called "continuation of historical waste reduction trend" which is based on the annual waste generation trend (i.e. reduction) observed over the last five years. Other authorities seem to have achieved greater reductions per capita compared to RBKC and this impacts the calculations considerably.

Option 2 Increase in recycling rate

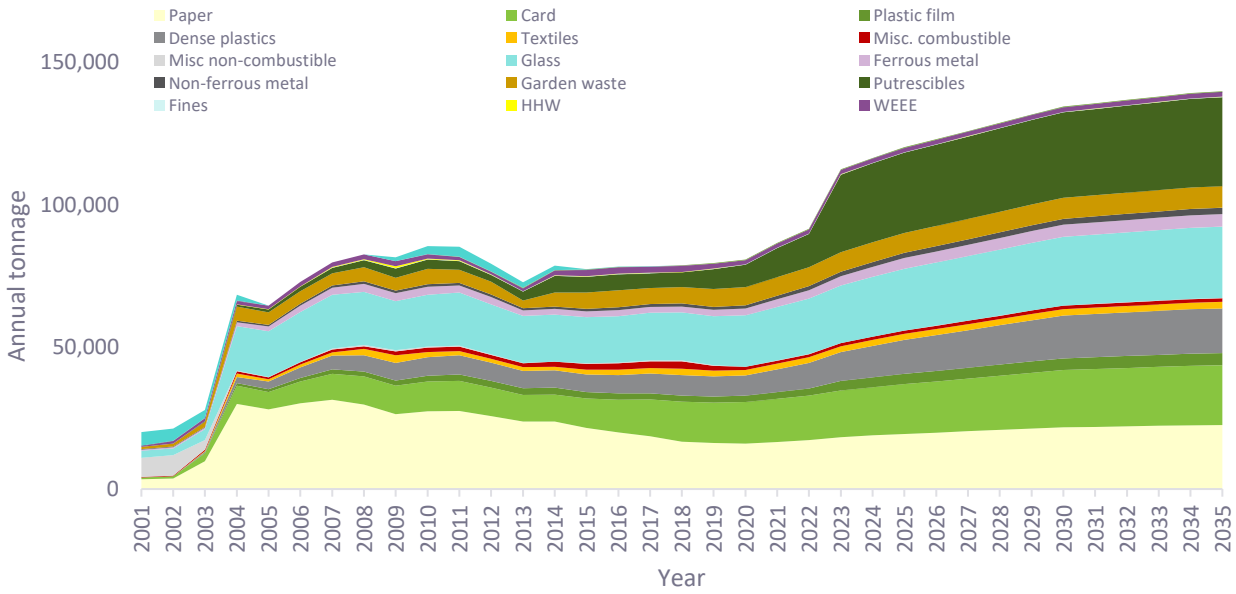
5.3.11 The assumptions behind option 2, as detailed in Appendix C, are as follows:

- Households achieve a 35% recycling rate by 2025 and 40% by 2030, as opposed to households achieving 45% household waste recycling rate by 2025 (50% by 2030) as per the Mayors non-binding target.
- Note: 40% recycling rate with no organics recycling translates to incredibly high dry recycling capture rates which may not be realistic - the Councils that are not currently collecting food waste (Wandsworth and H&F[1]) have therefore been modelled assuming that a food waste collection service is introduced by 2025, as well as full service roll out for Lambeth and RBKC.
- Capture rate does not exceed 85%. It should be noted that Wandsworth does not achieve 40% recycling rate by 2030. It is limited to 35% due to a realistic capture rate of 85% limit being reached before its target recycling rate. To improve this recycling rate, Wandsworth should target organics recycling. This could be achieved by implementing a garden waste collection service or capture of food waste.
- Continuation of comingled collection with no separation of materials, e.g. glass.

5.3.12 Figure 5.7 disaggregates the collected household recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

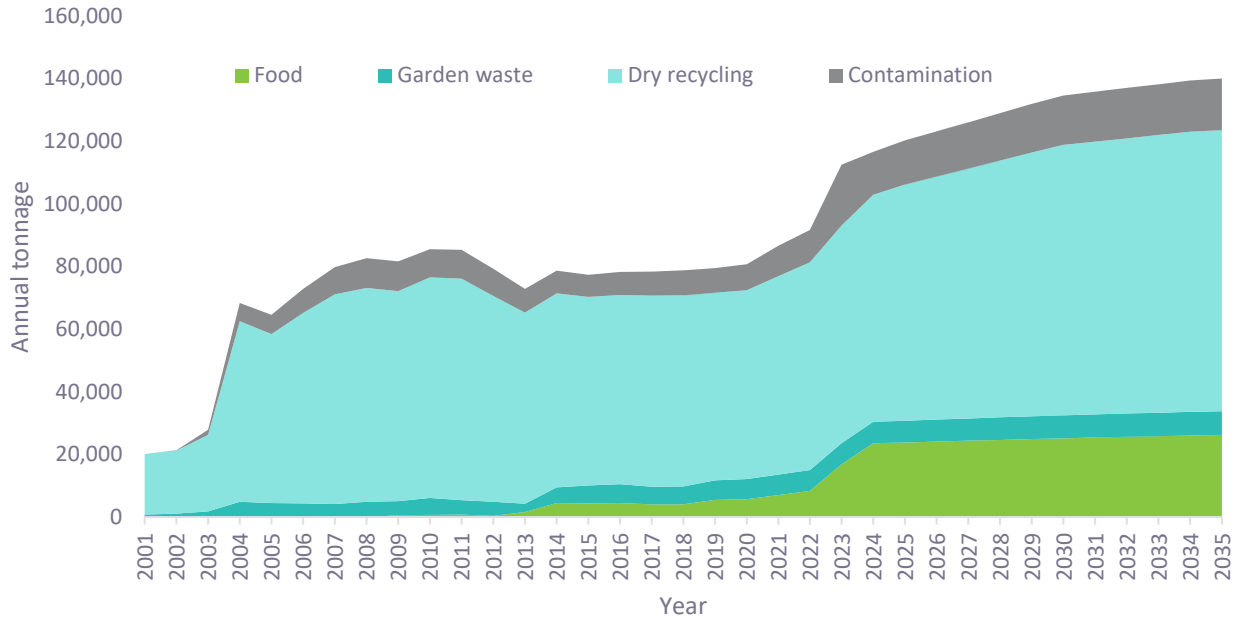
[1] it is noted that H&F started a trial food waste collection service in 2020

Figure 5.7 Option 2 - Total collected household recycling composition



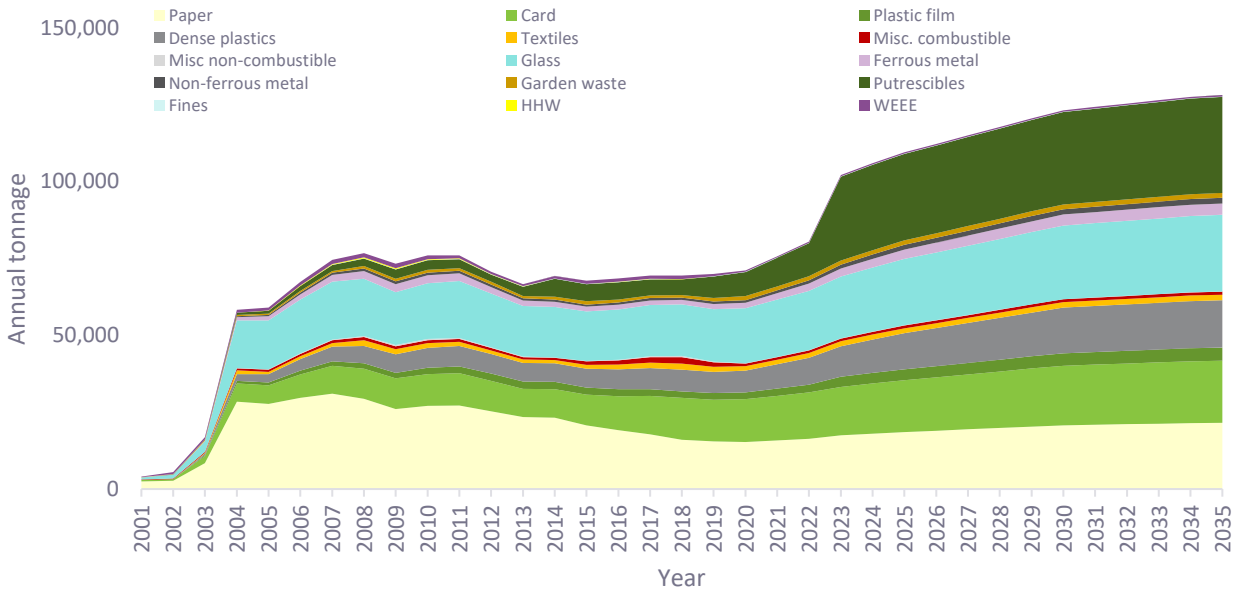
5.3.13 Figure 5.8 disaggregates the net kerbside recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.8 Option 2 - High level net household recycling composition



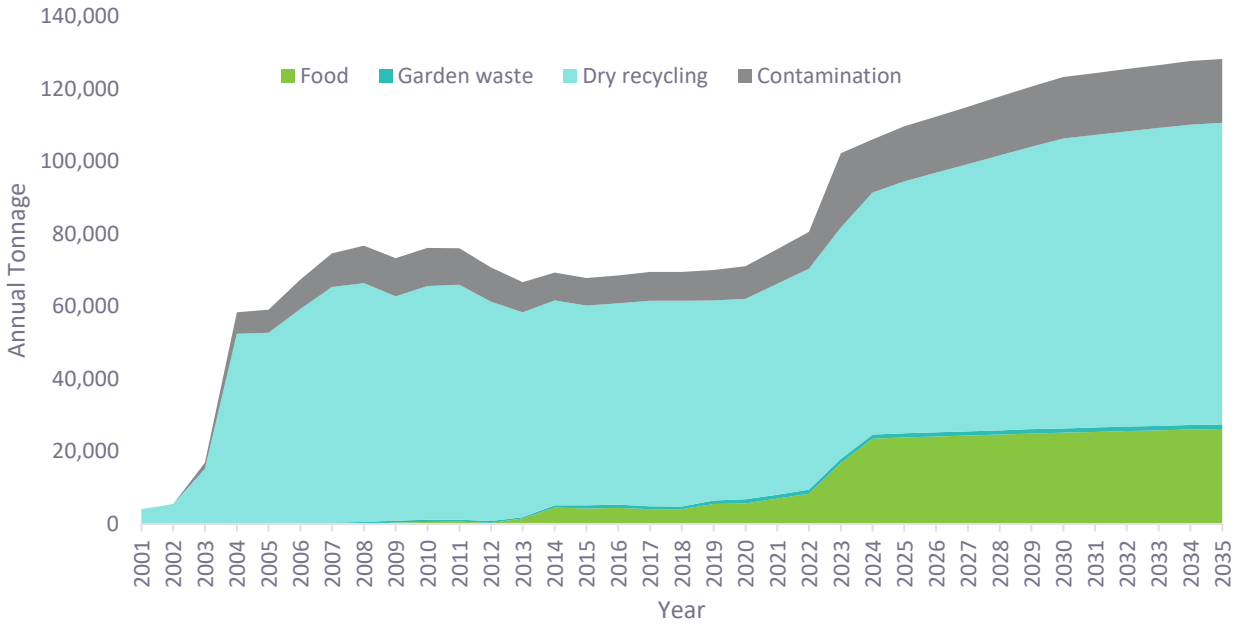
5.3.14 Figure 5.9 disaggregates the net kerbside recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.9 Option 2 - Kerbside collected household recycling composition



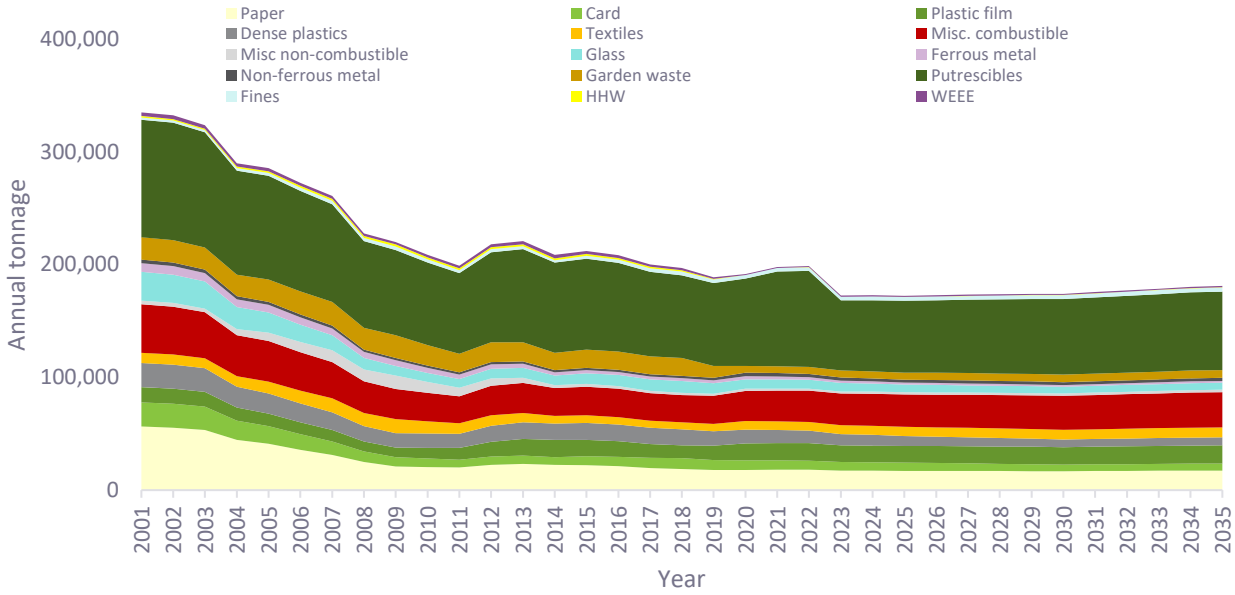
5.3.15 Figure 5.10 disaggregates the net kerbside recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.10 Option 2 - High level net kerbside recycling composition



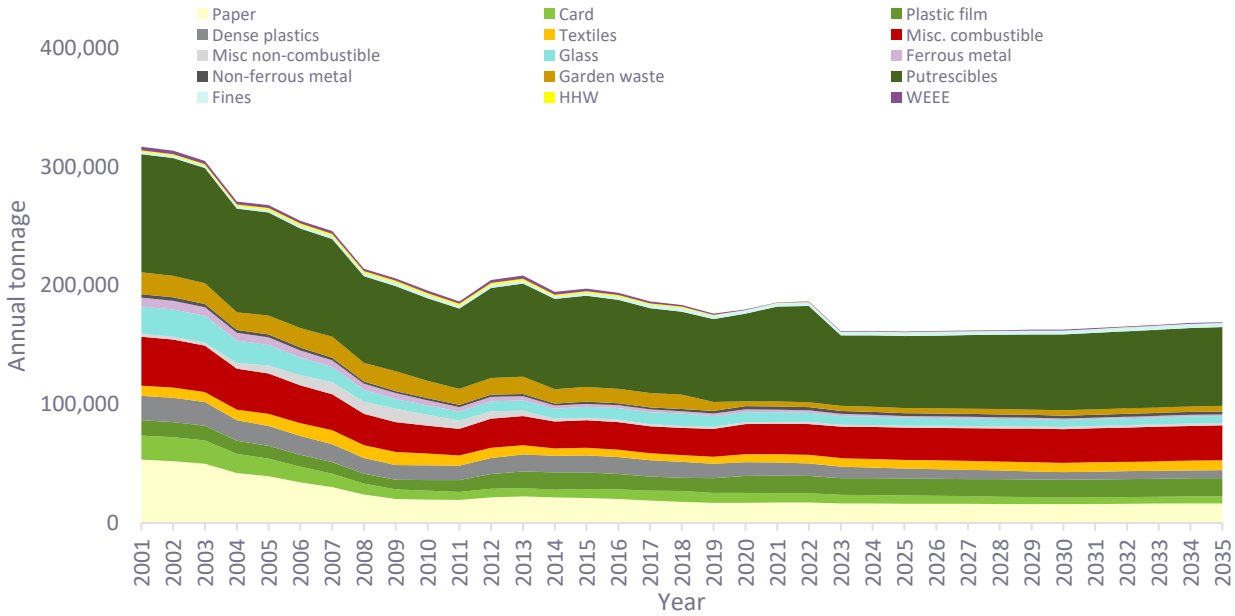
5.3.16 Figure 5.11 disaggregates the total collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.11 Option 2 - Total collected household residual waste composition



5.3.17 Figure 5.12 disaggregates the Kerbside collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.12 Option 2 - Kerbside collected residual waste composition



5.3.18 If the Authority/Councils were to implement the measures identified under option 2, the recycling rate achieved would be as presented in Table 5.2.

Table 5.2 Option 2 recycling rate for the Authority and Councils

KPI	WRWA	H&F	RBKC	Lambeth	Wandsworth
Recycling rate	38%	40%	41%	41%	35%

5.3.19 The modelling assumed that a recycling rate of 40% or a capture rate of 85% is achieved, whichever is met first, which is why Wandsworth achieves a 35% recycling rate under this option. To reach 40% recycling rate, the capture rate would need to increase to 95% for some materials, which is not considered realistic. Further recycling increases could be achieved by targeting organic materials (food waste and garden waste).

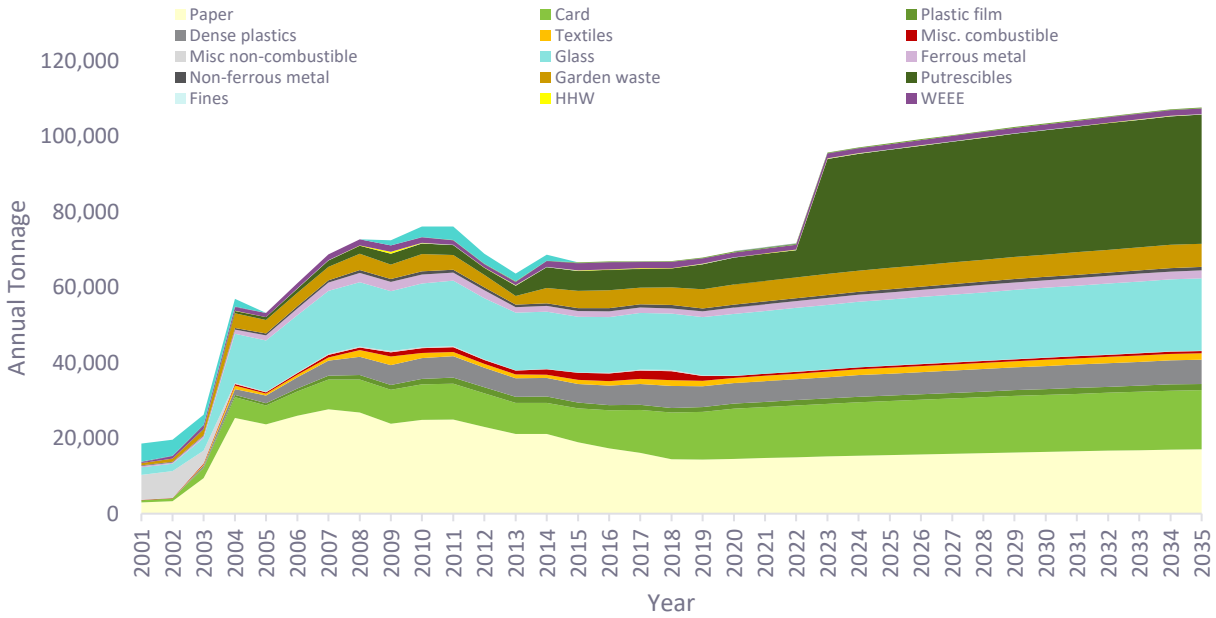
Option 3 Separate food waste collection to AD/IVC vs Status Quo

5.3.20 The assumptions behind option 3, as detailed in Appendix C, are as follows:

- No change in overall waste generated at household level or in the recycling rate of DMR and a food waste yield of 0.9 kg/hh/week for all Councils, to be in effect by 2023.

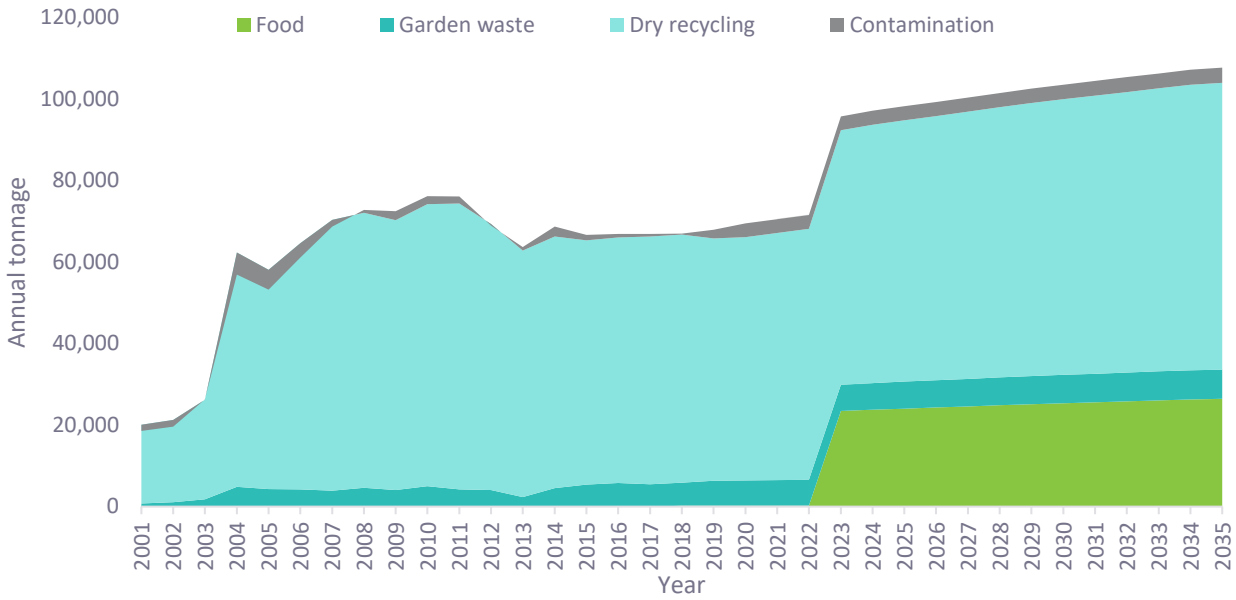
5.3.21 Figure 5.13 disaggregates the collected household recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.13 Option 3 - Total collected household recycling composition



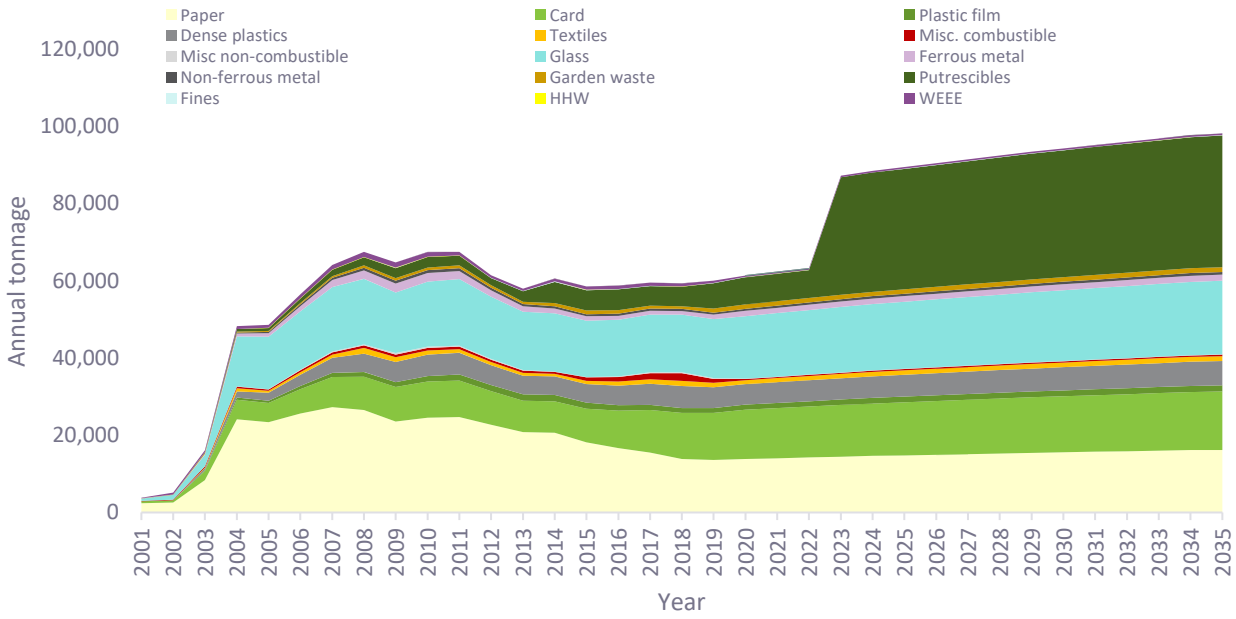
5.3.22 Figure 5.14 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.14 Option 3 - High level net household recycling composition



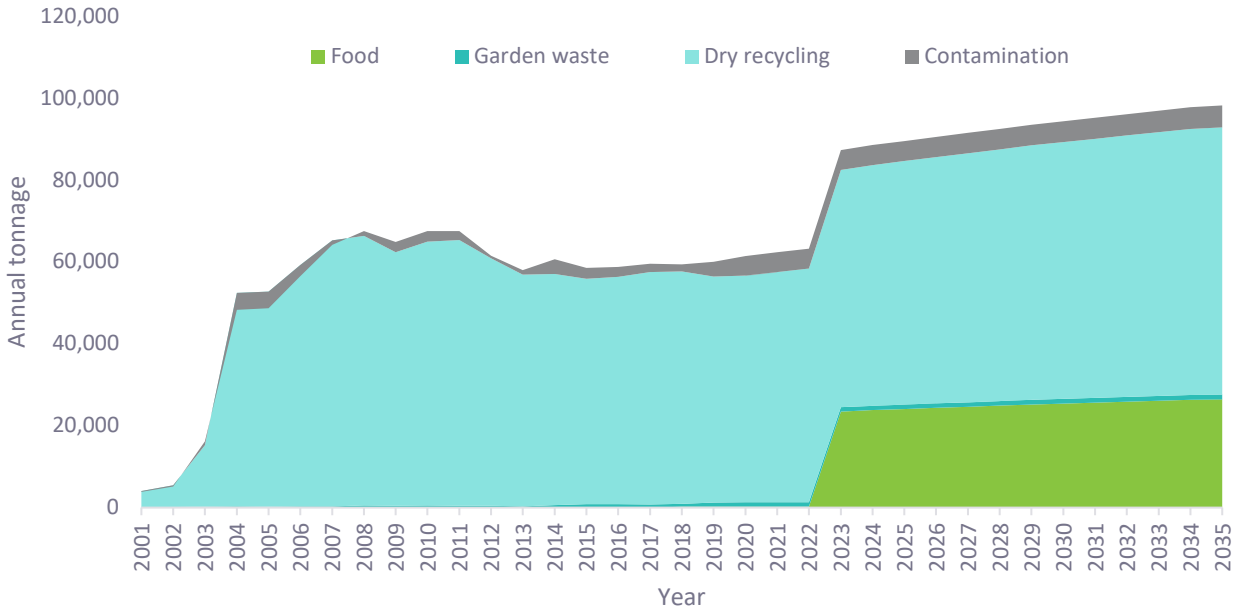
5.3.23 Figure 5.15 disaggregates the net kerbside recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.15 Option 3 - Kerbside collected household recycling composition



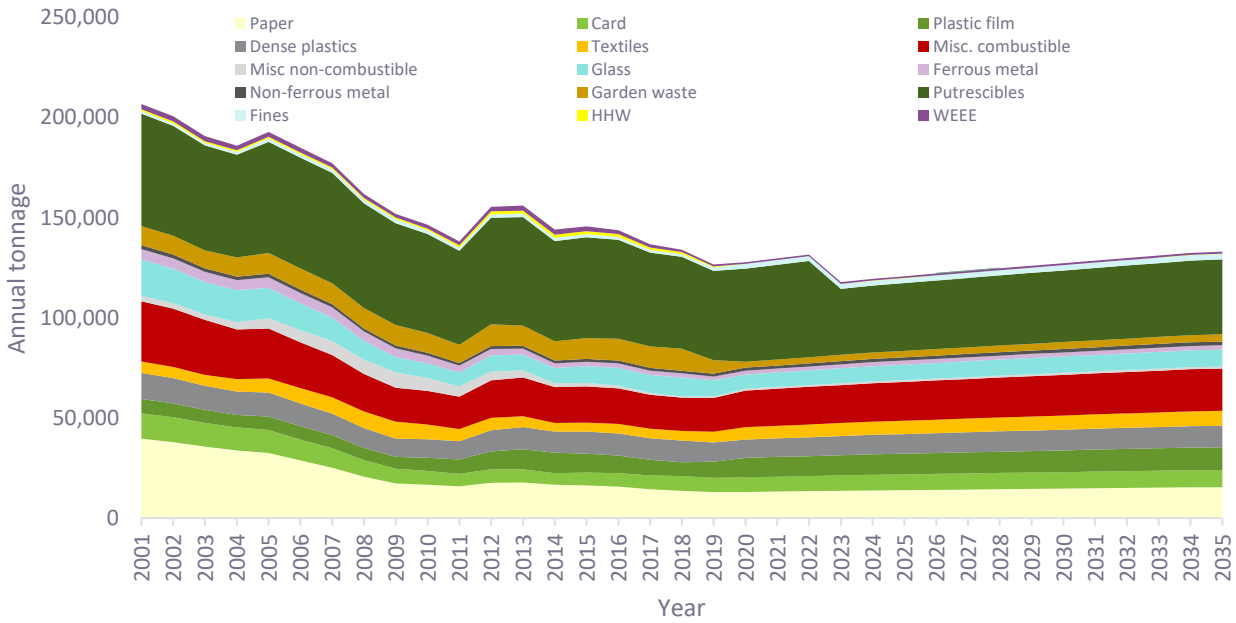
5.3.24 Figure 5.16 disaggregates the net kerbside recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.16 Option 3 - High level net kerbside recycling composition



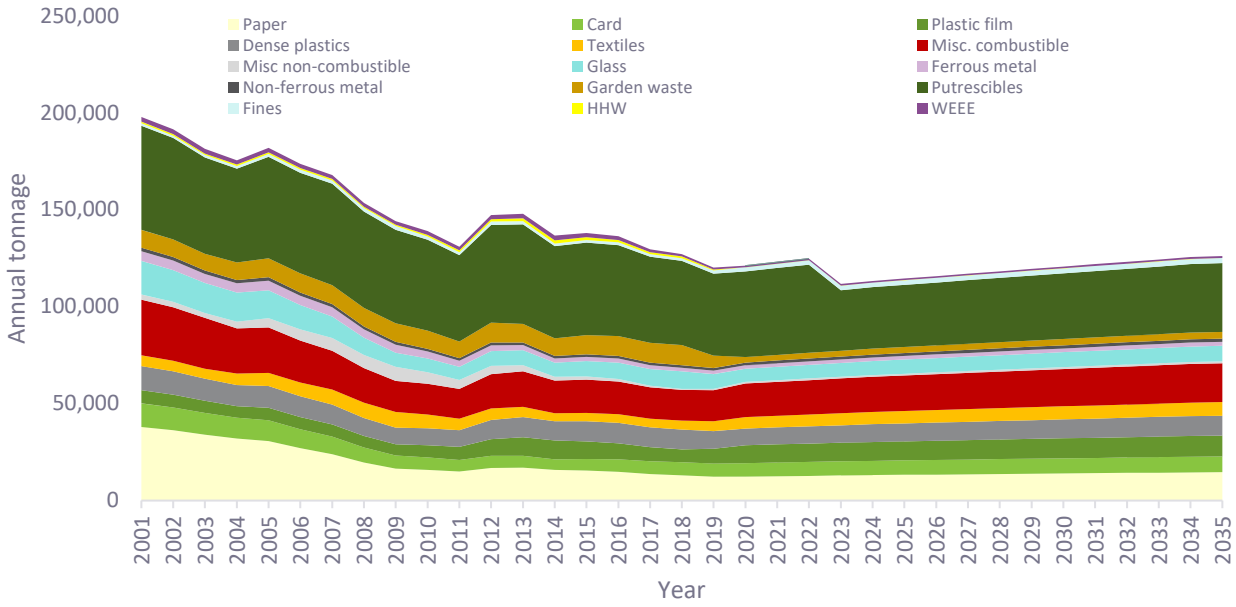
5.3.25 Figure 5.17 disaggregates the total collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.17 Option 3 - Total collected household residual waste composition



5.3.26 Figure 5.18 disaggregates the Kerbside collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.18 Option 3 - Kerbside collected residual waste composition



5.3.27 If the Authority/Councils were to implement the measures identified under option 3, the recycling rate achieved would be as presented in Table 5.3.

Table 5.3 Option 3 recycling rate for the Authority and Councils

KPI	WRWA	H&F	RBKC	Lambeth	Wandsworth
Recycling rate	32%	34%	35%	34%	29%

5.3.28 As expected, the recycling rate across all Councils increases when a dedicated food waste service is implemented. The largest increases against the baseline are seen for H&F and Wandsworth who currently have no food waste collection service in place.

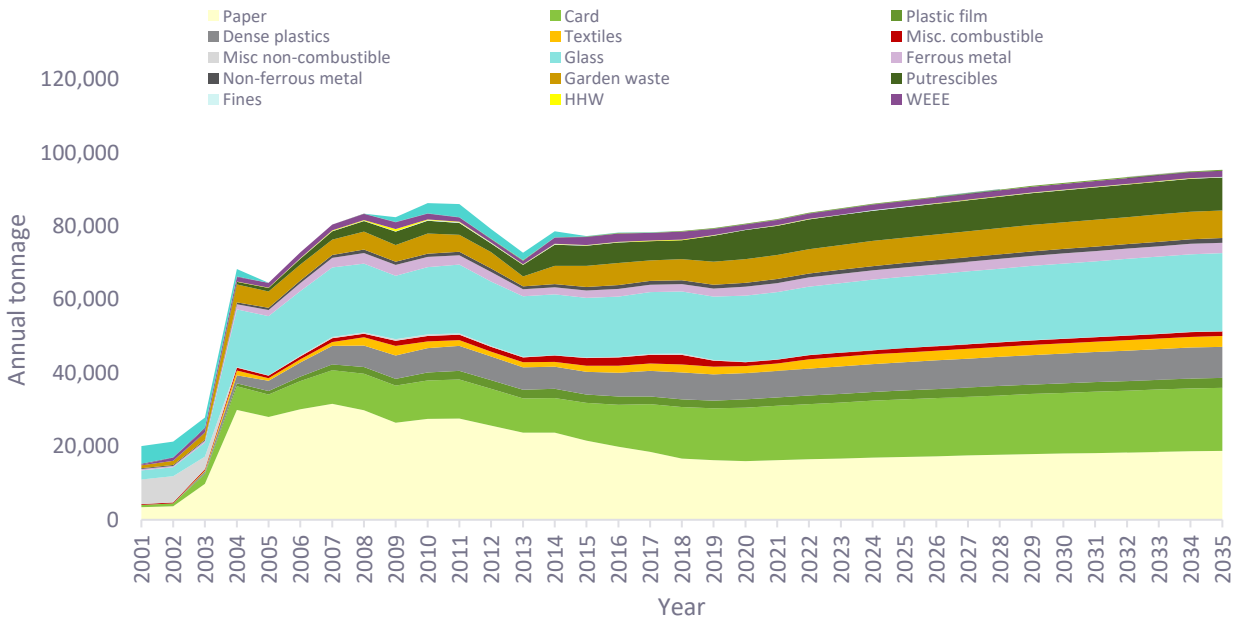
Option 4 Separate textiles collection

5.3.29 The assumptions behind option 4, as detailed in Appendix C, are as follows:

- Textile yield of 1.1kg/hh/yr
- Textiles collection commences in 2022; collections would either be carried out by existing collection rounds (given the low yields) or collected by charities.

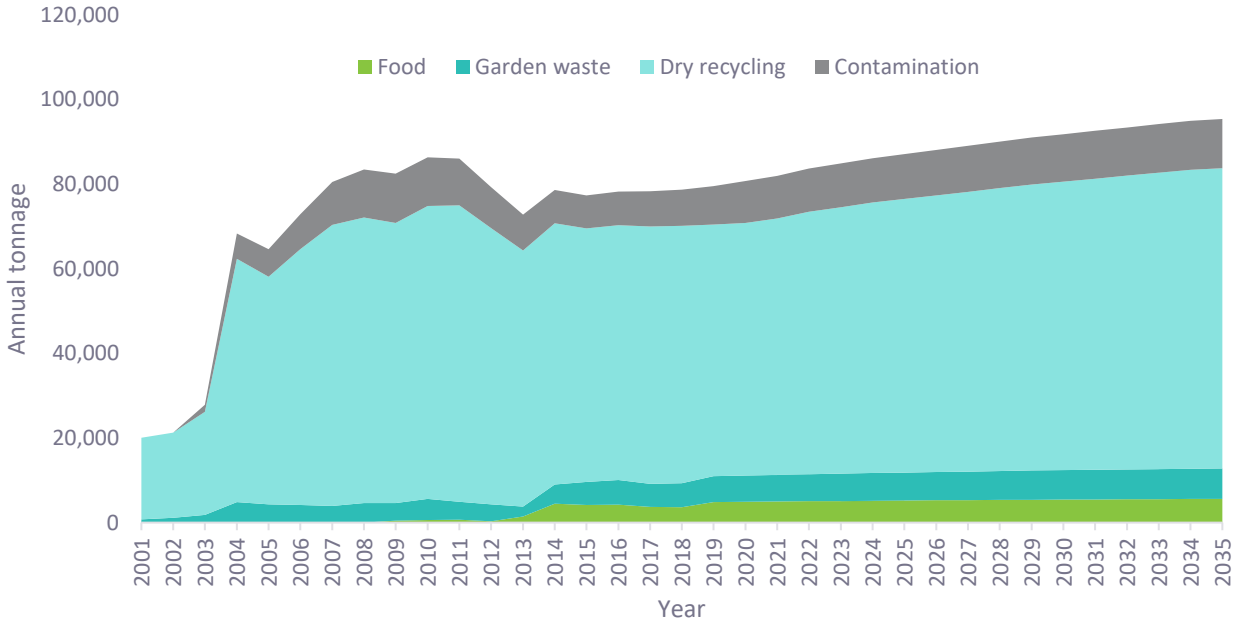
5.3.30 Figure 5.19 disaggregates the collected household recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.19 Option 4 - Total collected household recycling composition



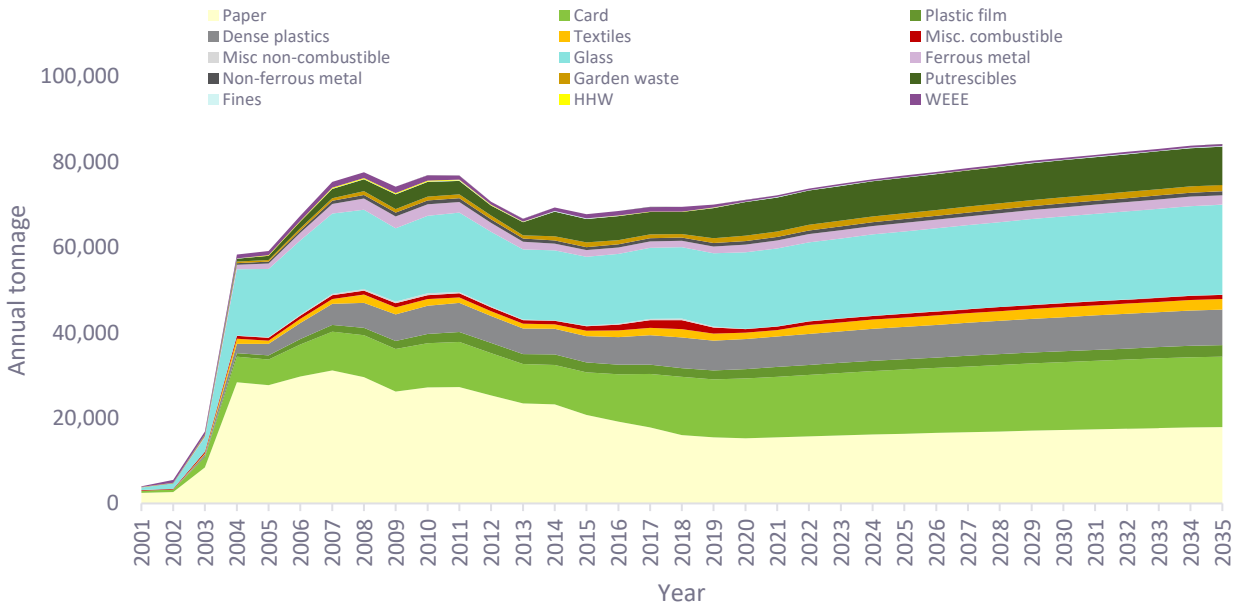
5.3.31 Figure 5.20 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.20 Option 4 - High level net household recycling composition



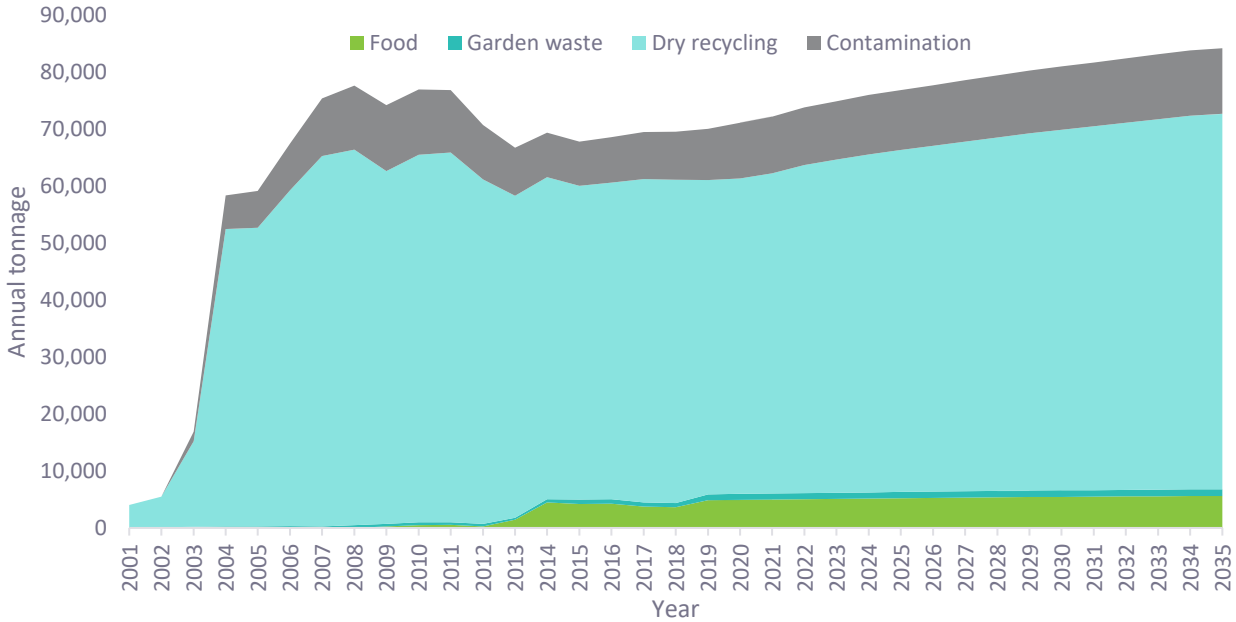
5.3.32 Figure 5.21 disaggregates the net kerbside recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.21 Option 4 - Kerbside collected household recycling composition



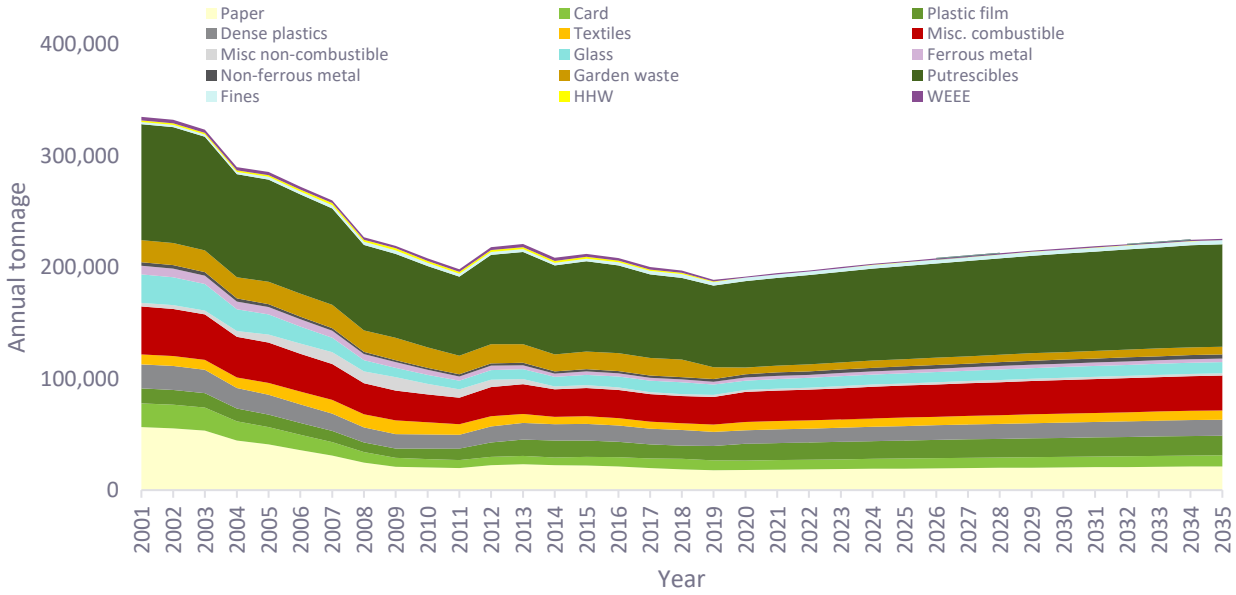
5.3.33 Figure 5.22 disaggregates the net kerbside recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.22 Option 4 - High level net kerbside recycling composition



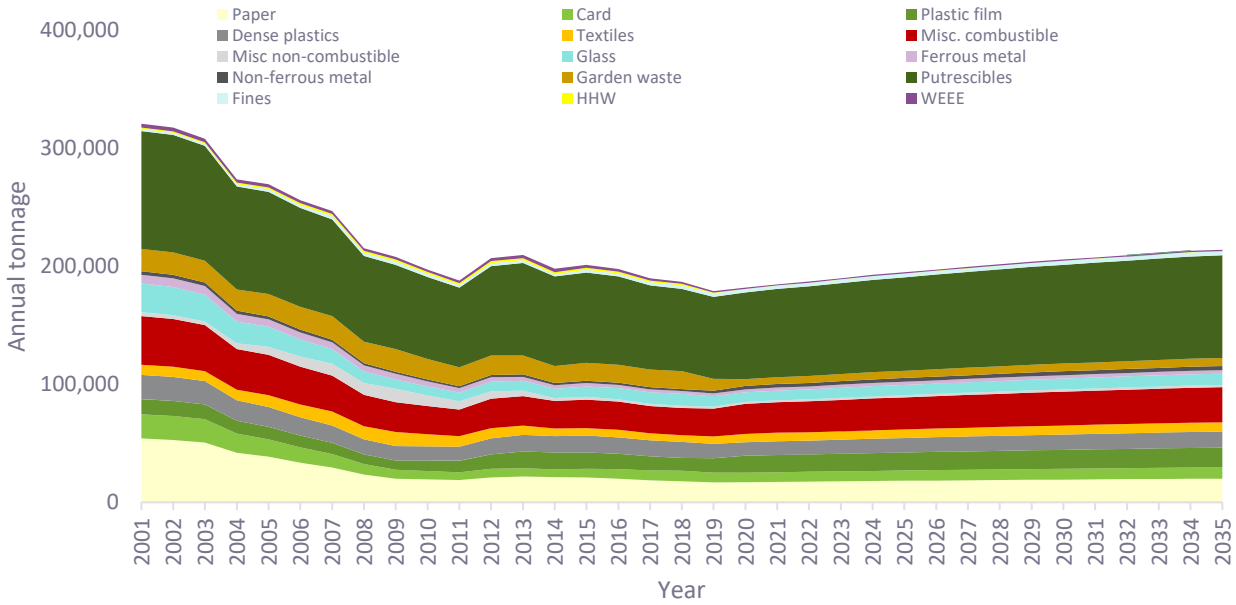
5.3.34 Figure 5.23 disaggregates the total collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.23 Option 4 - Total collected household residual waste composition



5.3.35 Figure 5.24 disaggregates the Kerbside collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.24 Option 4 - Kerbside collected residual waste composition



5.3.36 If the Authority/Councils were to implement the measures identified under option 4, the recycling rate achieved would be as presented in Table 5.4.

Table 5.4 Option 4 recycling rate for the Authority and Councils

KPI	WRWA	H&F	RBKC	Lambeth	Wandsworth
Recycling rate	26%	25%	27%	32%	21%

5.3.37 Due to the small tonnages of textiles collected under this option, very little difference is made to the recycling rate in comparison to the baseline, across all Councils. To achieve higher recycling rates, there would need to be targeted efforts, e.g. communications, to increase the amount of textiles residents put out separately for collection.

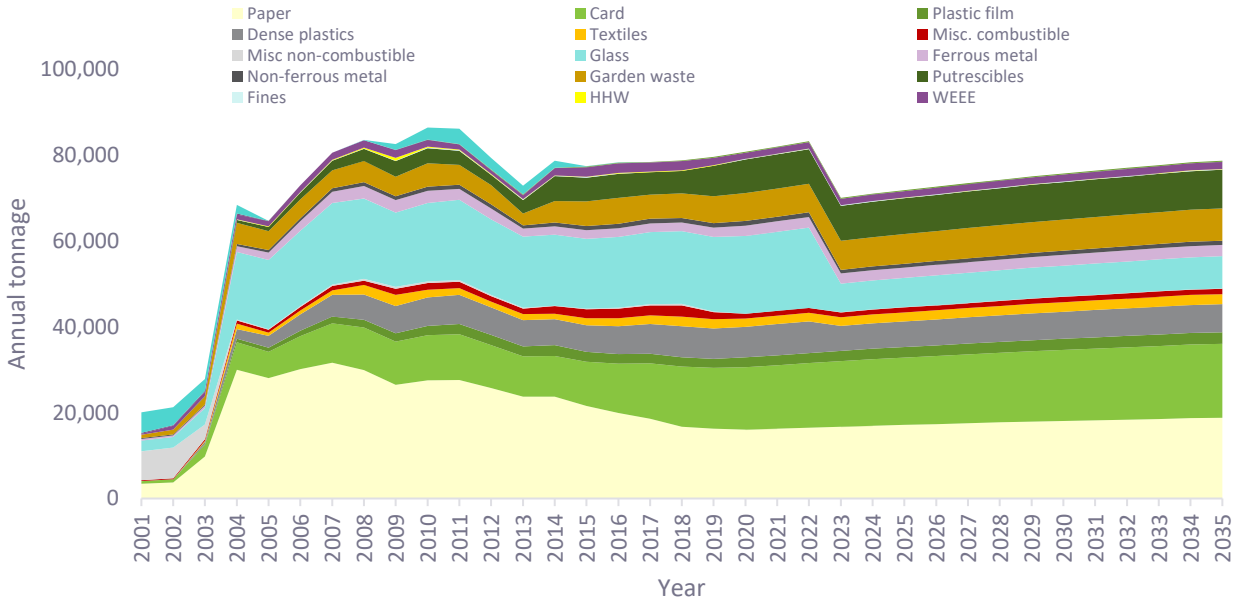
Option 5 Reduction of packaging waste (DRS assessment)

5.3.38 The assumptions behind option 5, as detailed in Appendix C, are as follows:

- DRS 'all-in' option in 2023 and that 85% of the following materials are transferred from kerbside recycling and refuse waste collections to DRS recycling collections: PET drinks bottles, steel and aluminium drink cans and glass drinks bottles
- The remaining 15% goes to kerbside collections.

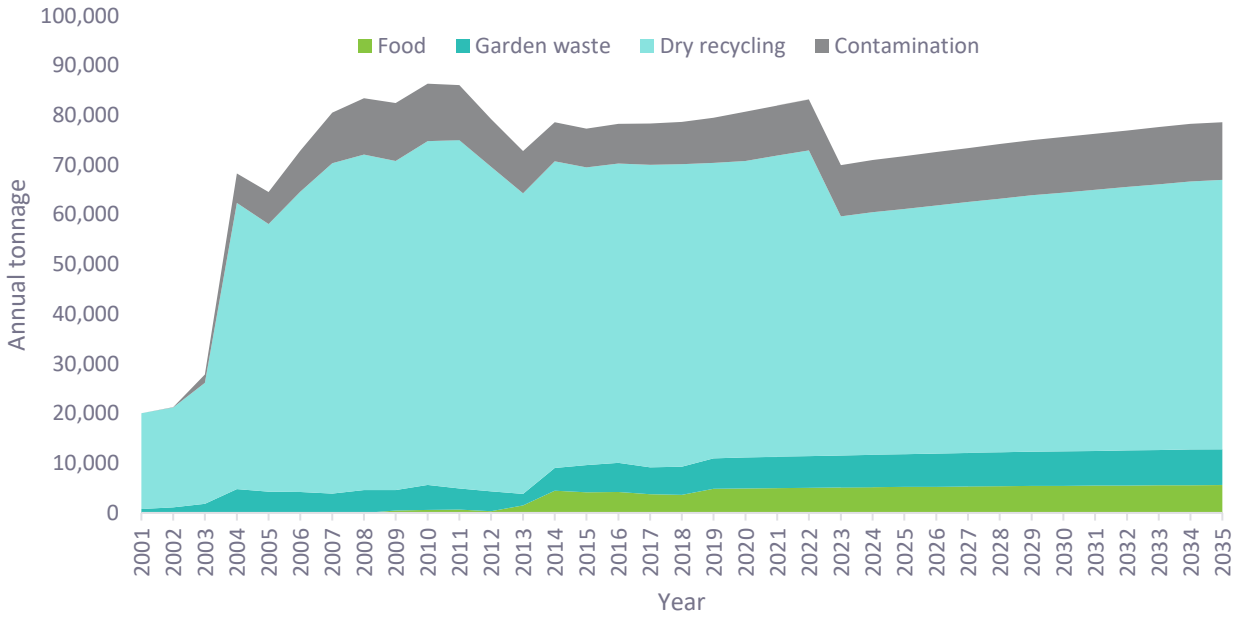
5.3.39 Figure 5.25 disaggregates the collected household recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.25 Option 5 - Total collected household recycling composition



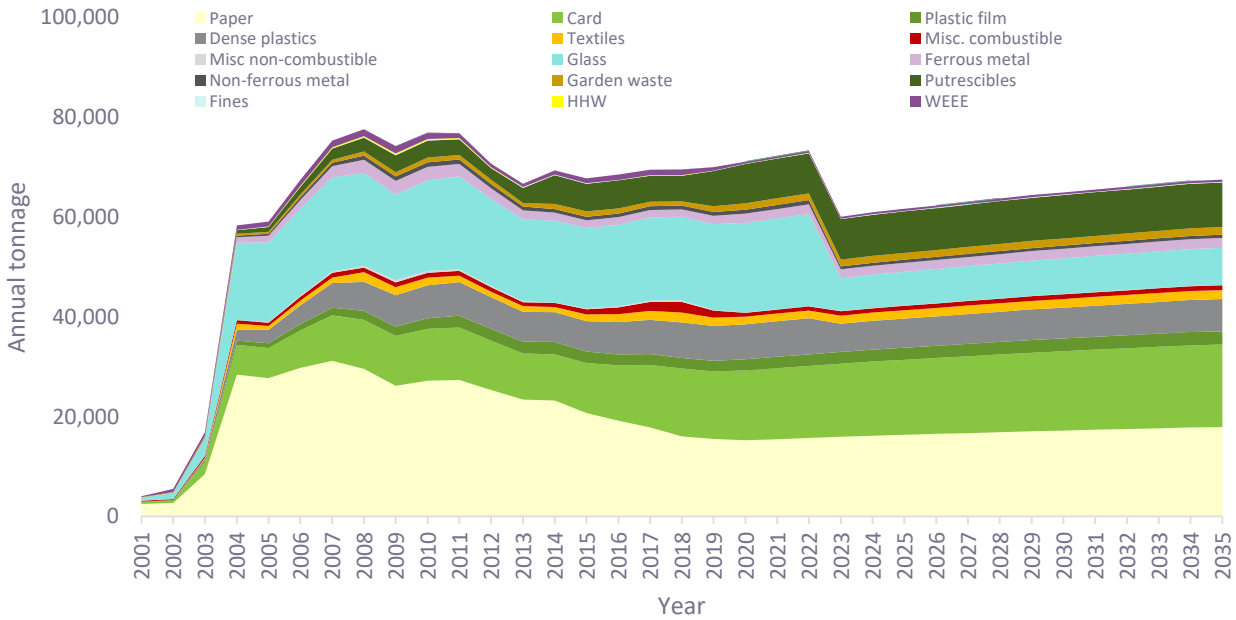
5.3.40 Figure 5.26 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.26 Option 5 - High level net household recycling composition



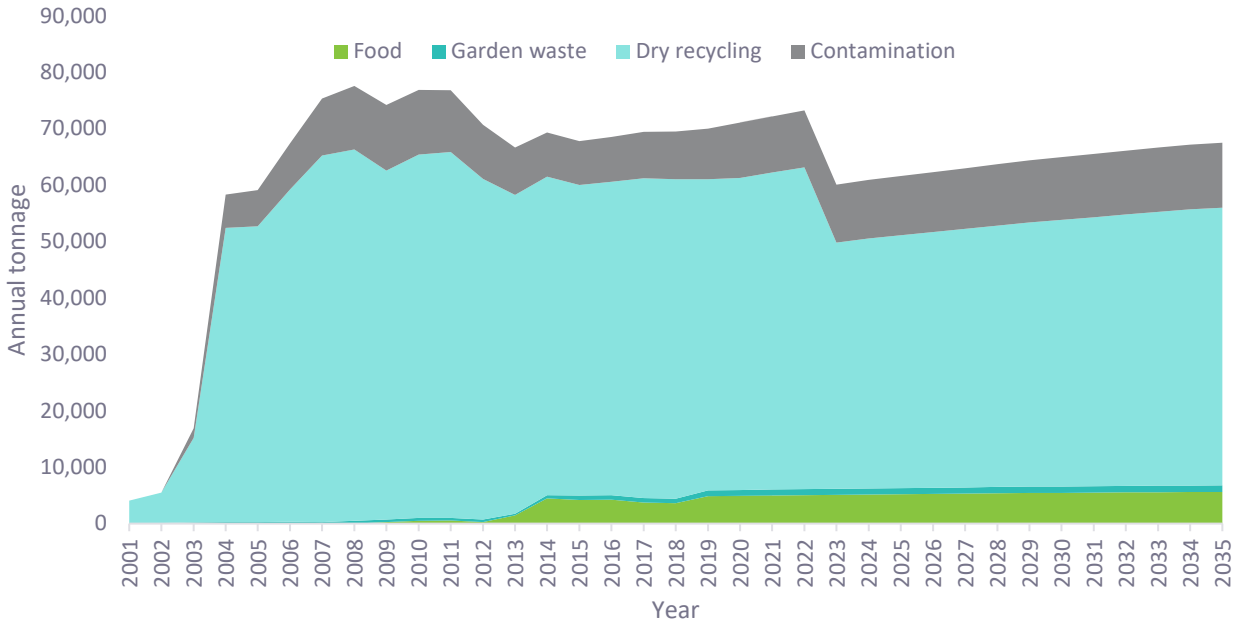
5.3.41 Figure 5.27 disaggregates the net kerbside recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.27 Option 5 - Kerbside collected household recycling composition



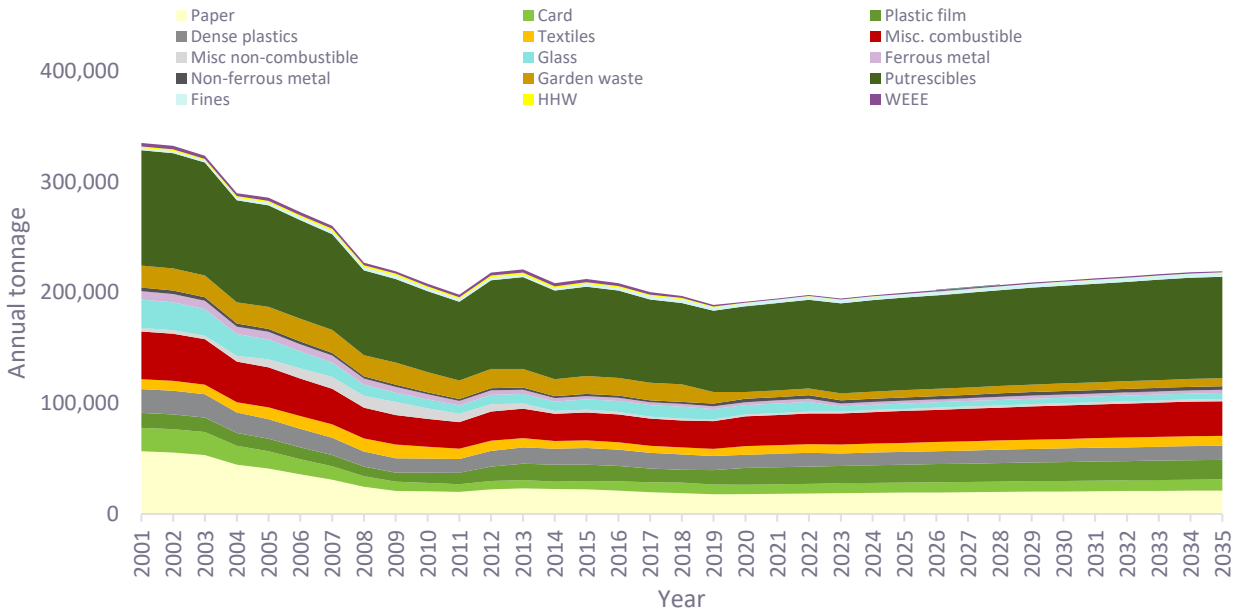
5.3.42 Figure 5.28 disaggregates the net kerbside recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.28 Option 5 - High level net kerbside recycling composition



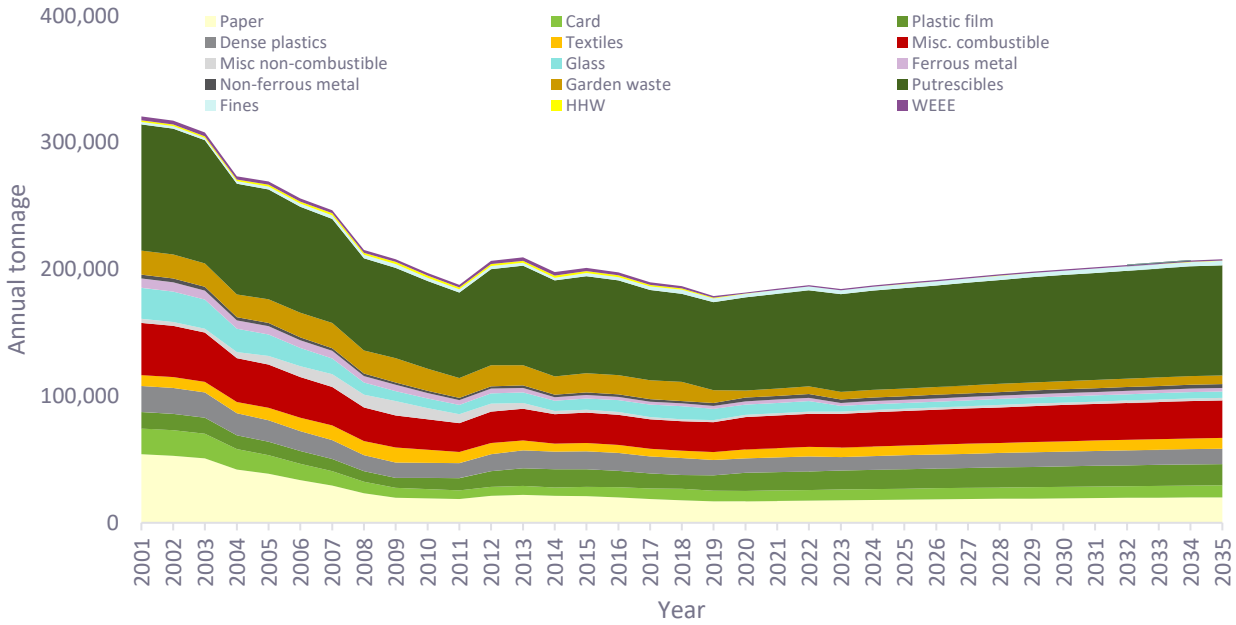
5.3.43 Figure 5.29 disaggregates the total collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.29 Option 5 - Total collected household residual waste composition



5.3.44 Figure 5.30 disaggregates the Kerbside collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.30 Option 5 - Kerbside collected residual waste composition



5.3.45 If the Authority/Councils were to implement the measures identified under option 5, the recycling rate achieved would be as presented in Table 5.5.

Table 5.5 Option 5 recycling rate and waste minimisation for the Authority and Councils

KPI	WRWA	H&F	RBKC	Lambeth	Wandsworth
Recycling rate	22%	21%	22%	29%	18%
Waste minimisation (against the baseline)	22,216	4,525	5,007	5,735	6,949

5.3.46 Under option 5, there is a reduction in the recycling rate across all Councils as a result of recyclable materials (drinks packaging) being taken out of the kerbside recycling waste stream. There is a however a reduction in overall waste tonnages as a result of DRS. The differing compositions between Councils is reflected in the amount of waste minimisation achieved.

5.3.47 Ultimately, the level of minimisation achieved will depend on the level of participation by residents in using the DRS infrastructure to return drinks packaging.

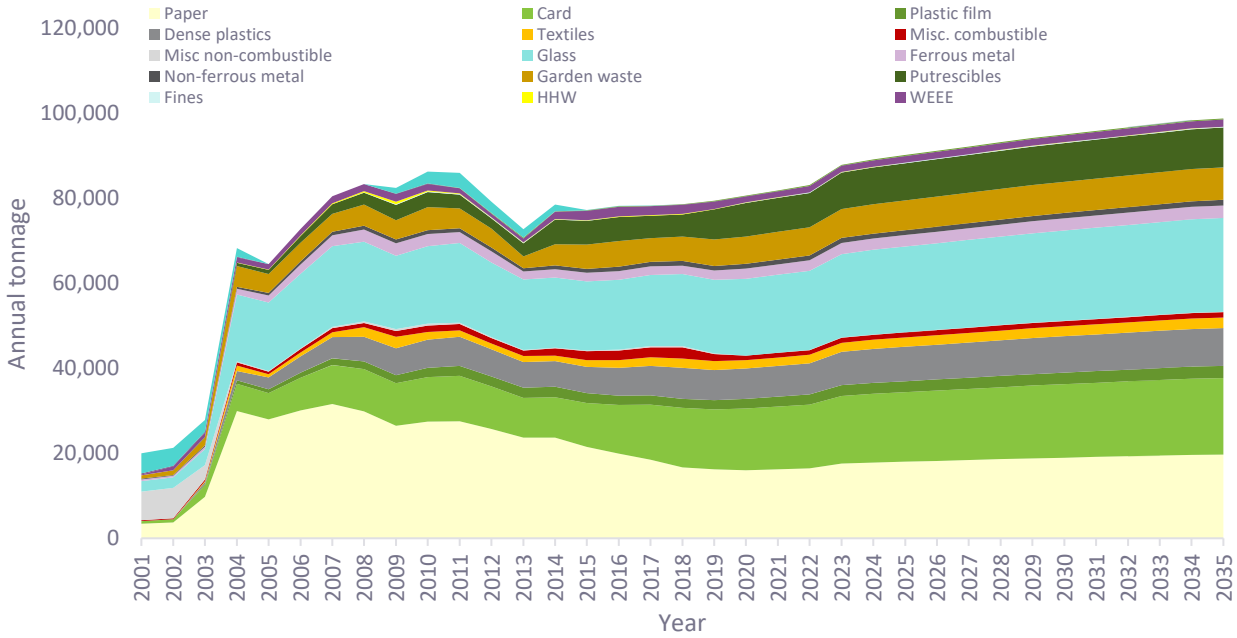
Option 7 Alternate weekly collections (AWC)

5.3.48 The assumptions behind option 7, as detailed in Appendix C, are as follows:

- Applicable to kerbside properties only
- Evidence from WRAP on reducing frequency of collections (+11% in dry recycling capture compared from moving residual waste to fortnightly from weekly).

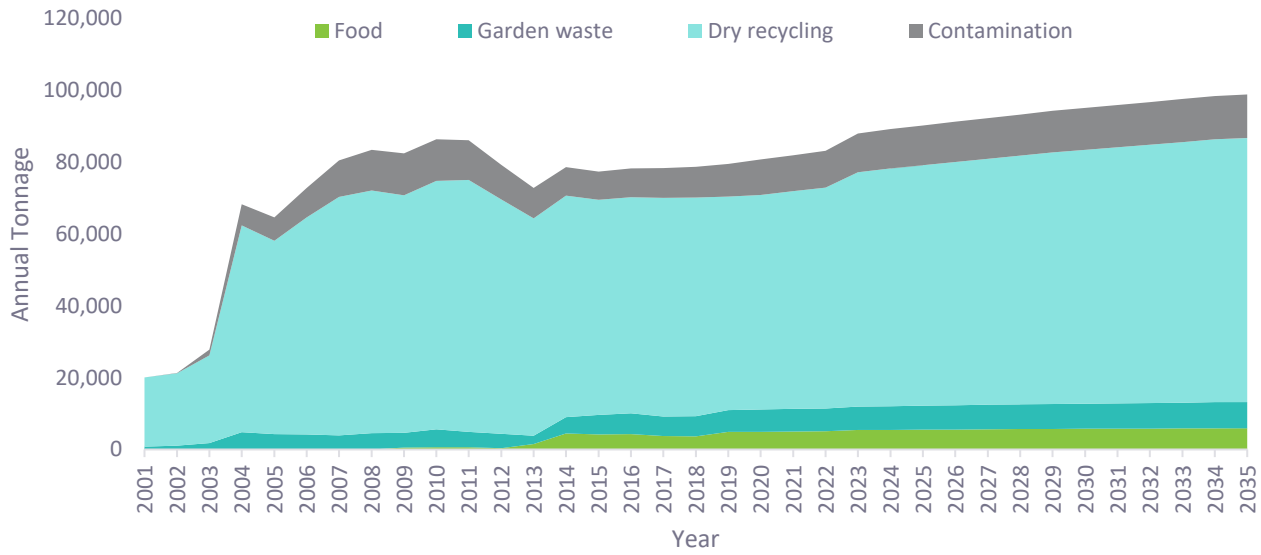
5.3.49 Figure 5.31 disaggregates the collected household recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.31 Option 7 - Total collected household recycling composition



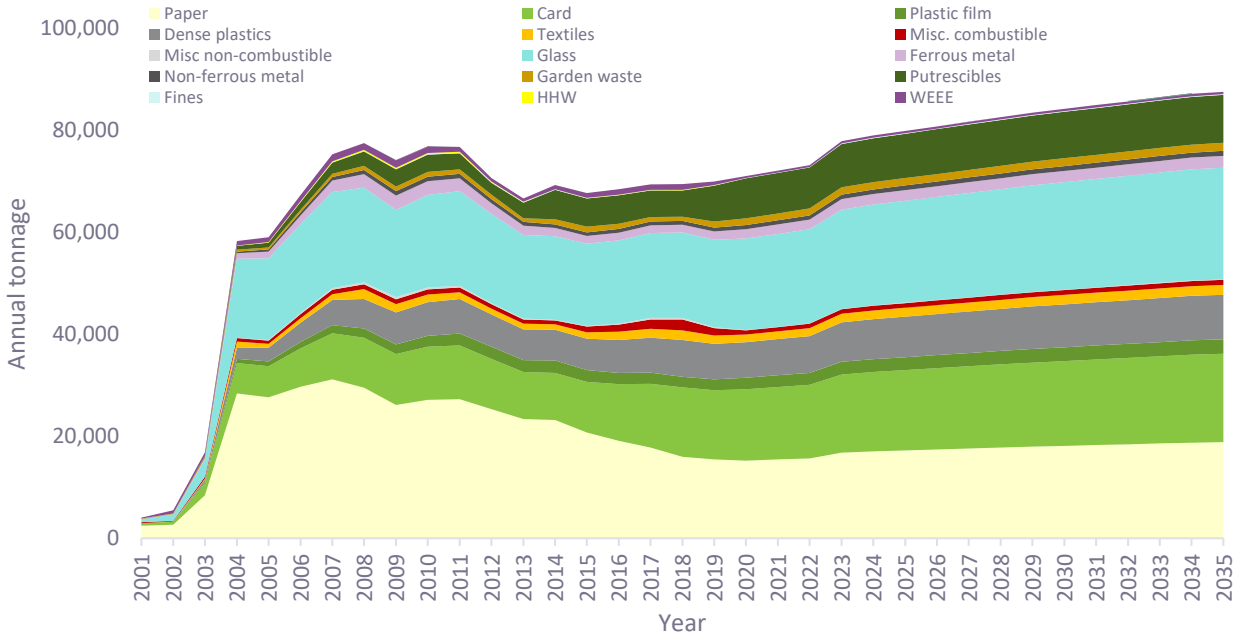
5.3.50 Figure 5.32 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.32 Option 7 - High level net household recycling composition



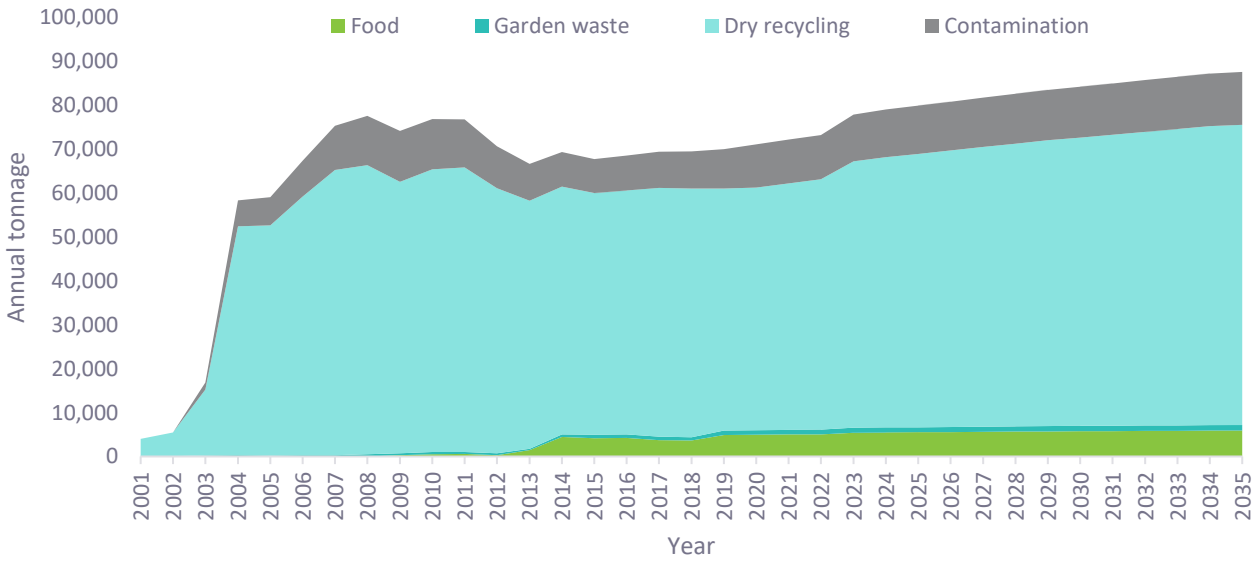
5.3.51 Figure 5.33 disaggregates the net kerbside recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.33 Option 7 - Kerbside collected household recycling composition



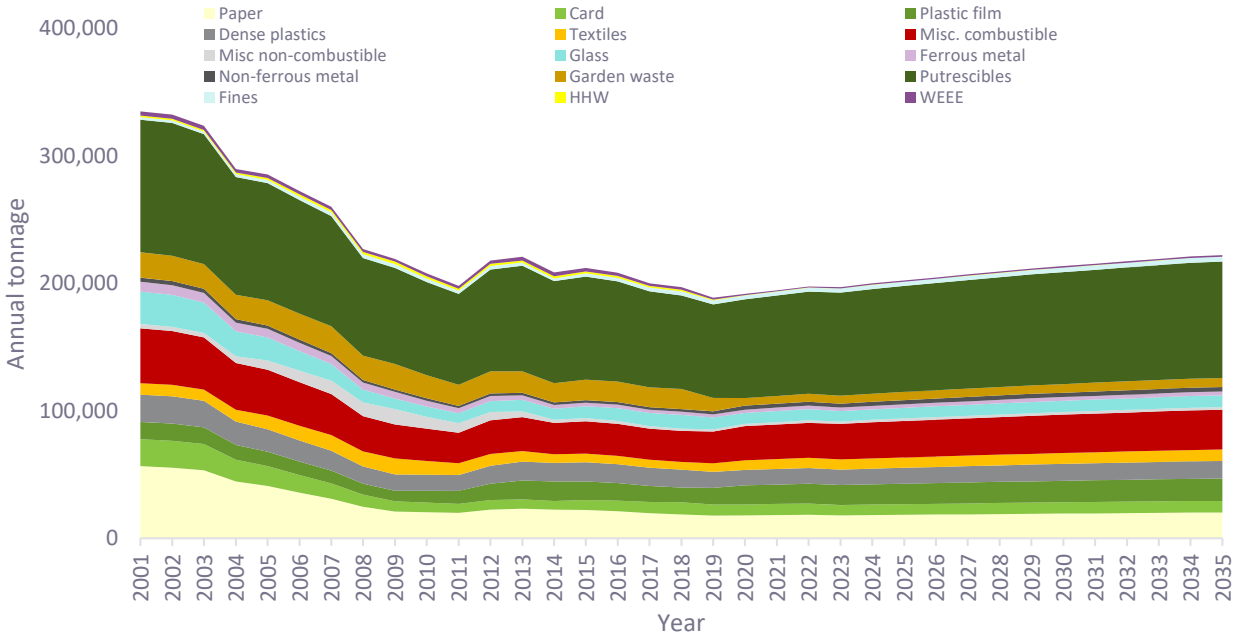
5.3.52 Figure 5.34 disaggregates the net kerbside recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.34 Option 7 - High level net kerbside recycling composition



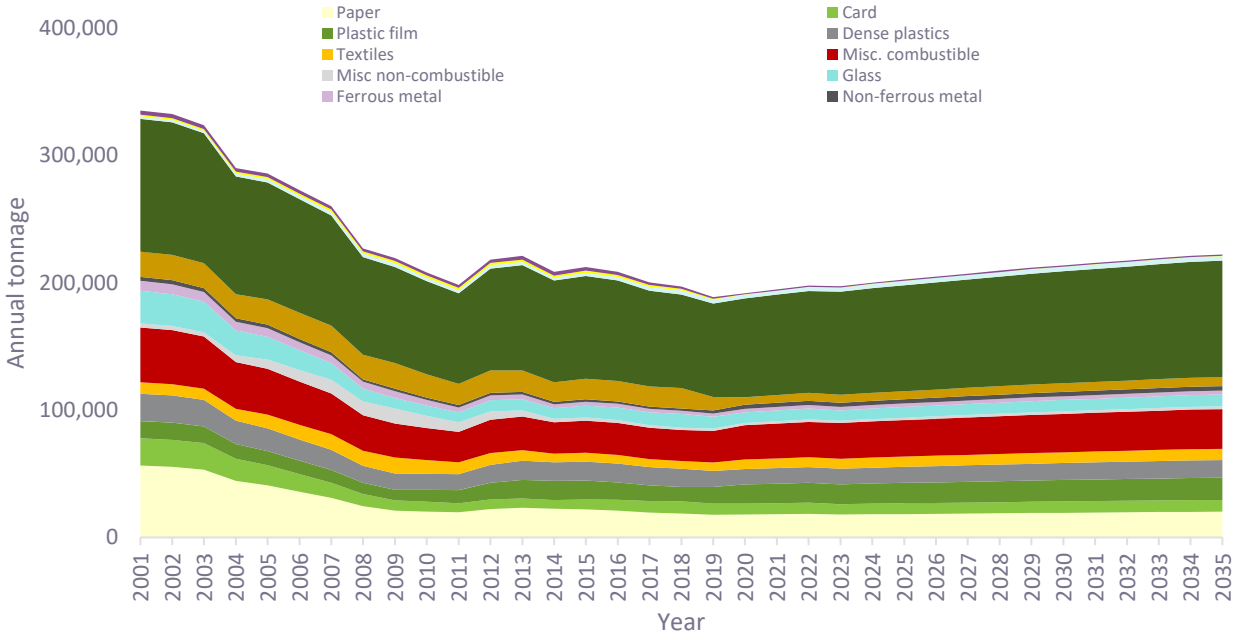
5.3.53 Figure 5.35 disaggregates the total collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.35 Option 7 - Total collected household residual waste composition



5.3.54 Figure 5.36 disaggregates the Kerbside collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.36 Option 7 - Kerbside collected residual waste composition



5.3.55 If the Authority/Councils were to implement an AWC, the recycling rate achieved would be as presented in Table 5.6.

Table 5.6 Option 7 recycling rate for the Authority and Councils

KPI	WRWA	H&F	RBKC	Lambeth	Wandsworth
Recycling rate	27%	27%	28%	33%	22%

5.3.56 This shows that there would be a marginal increase in the level of recycling achieved by implementing an AWC.

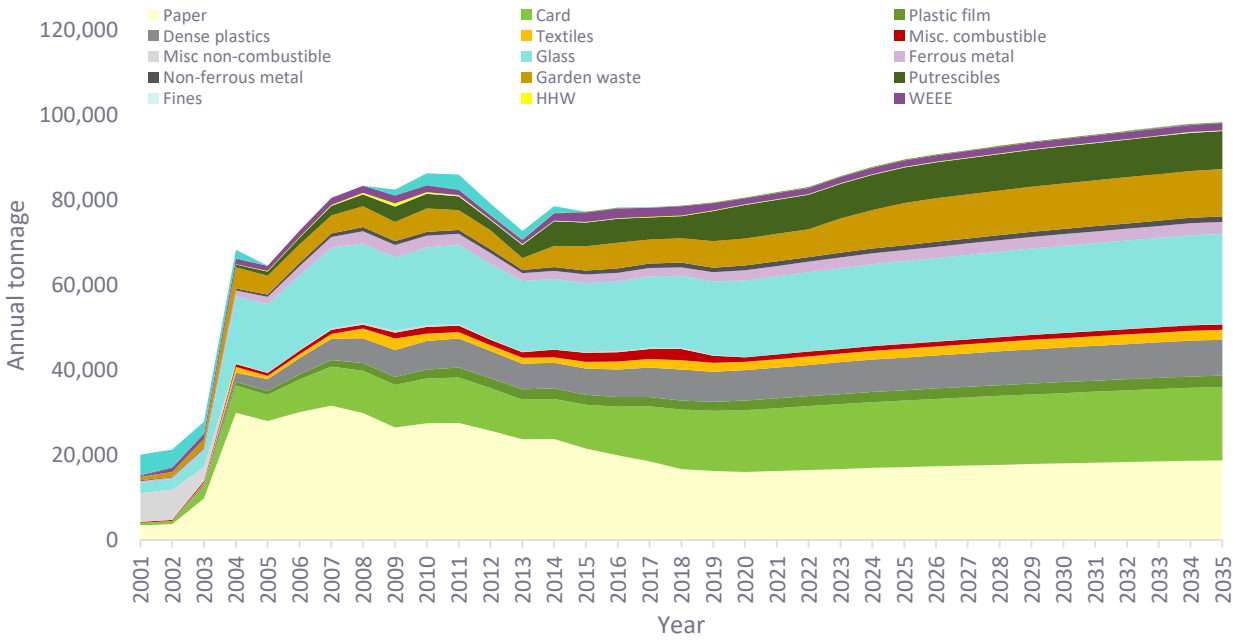
Option 8 Separate Garden Waste Collection

5.3.57 The assumptions behind option 8, as detailed in Appendix C, are as follows:

- Applicable to kerbside properties only
- Lambeth participation/ service take-up rate of 6% of the street level properties
- Projected kerbside yield of 95.6 kg/hh/yr per household participating
- Maximum level of participation level reached in year 3/4 from the introduction of the service.

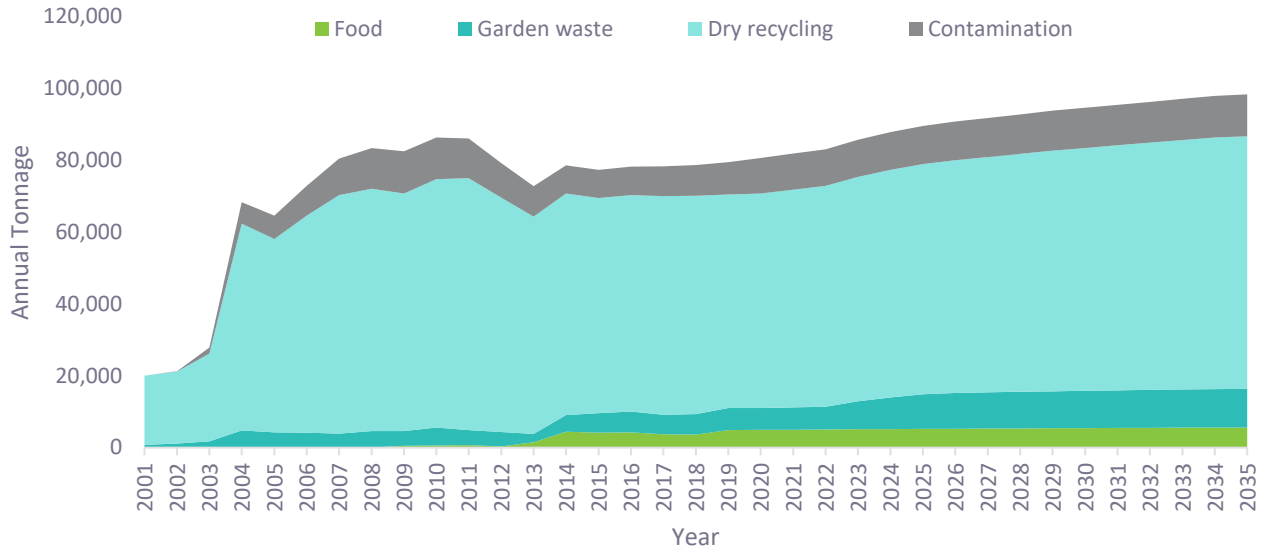
5.3.58 Figure 5.37 disaggregates the collected household recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.37 Option 8 - Total collected household recycling composition



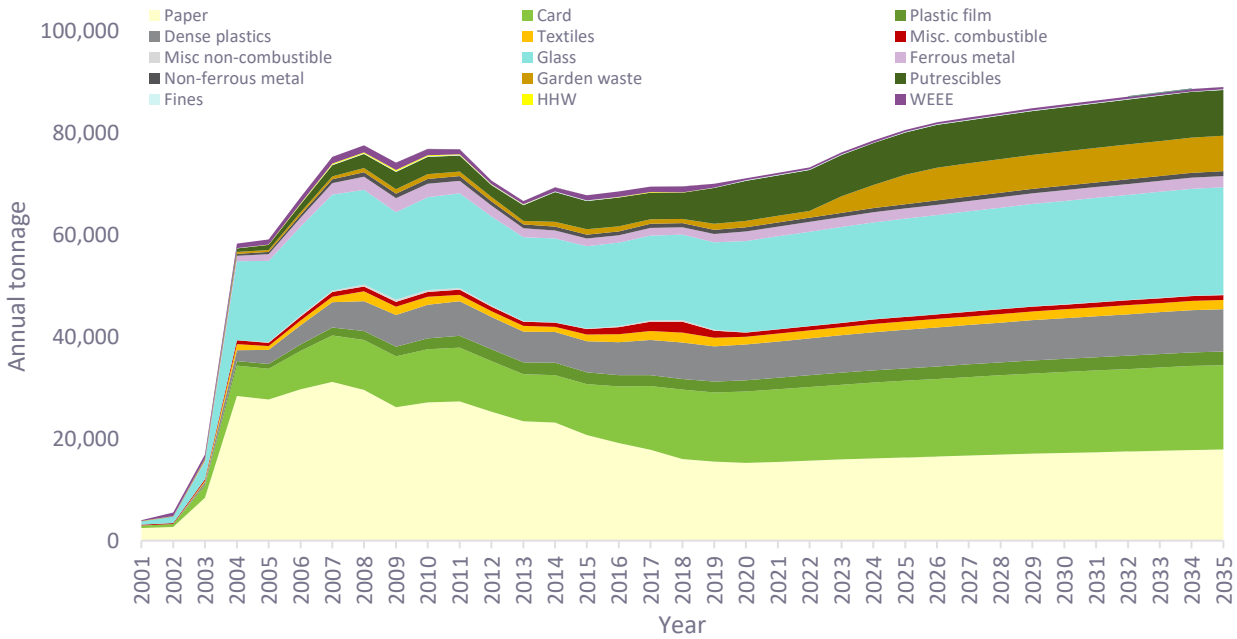
5.3.59 Figure 5.38 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.38 Option 8 - High level net household recycling composition



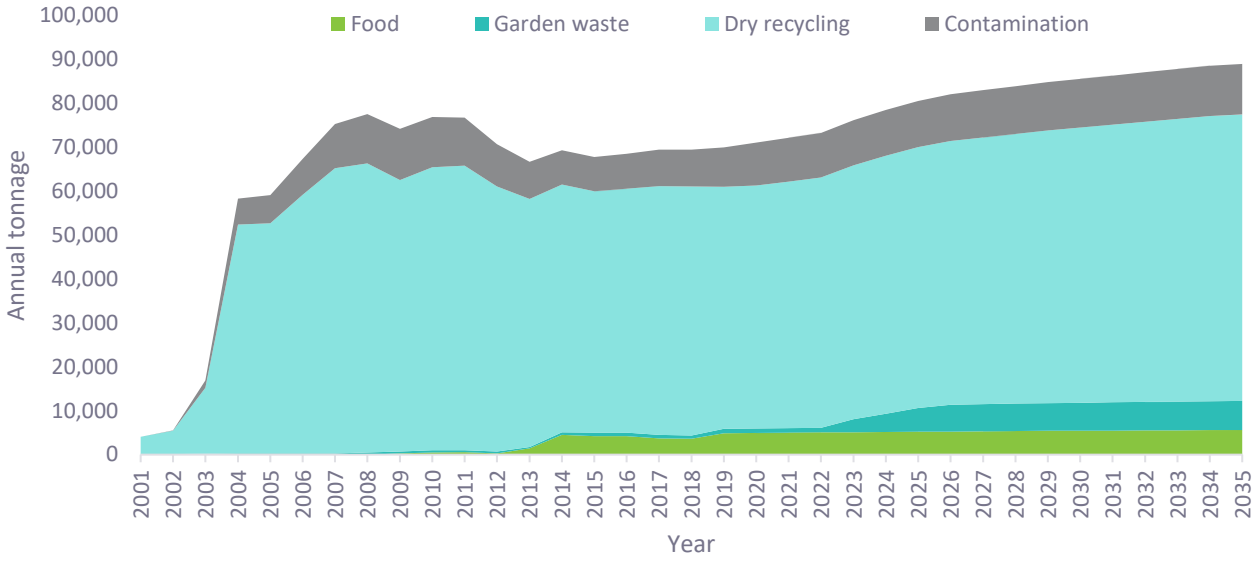
5.3.60 Figure 5.39 disaggregates the net kerbside recycling into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.39 Option 8 - Kerbside collected household recycling composition



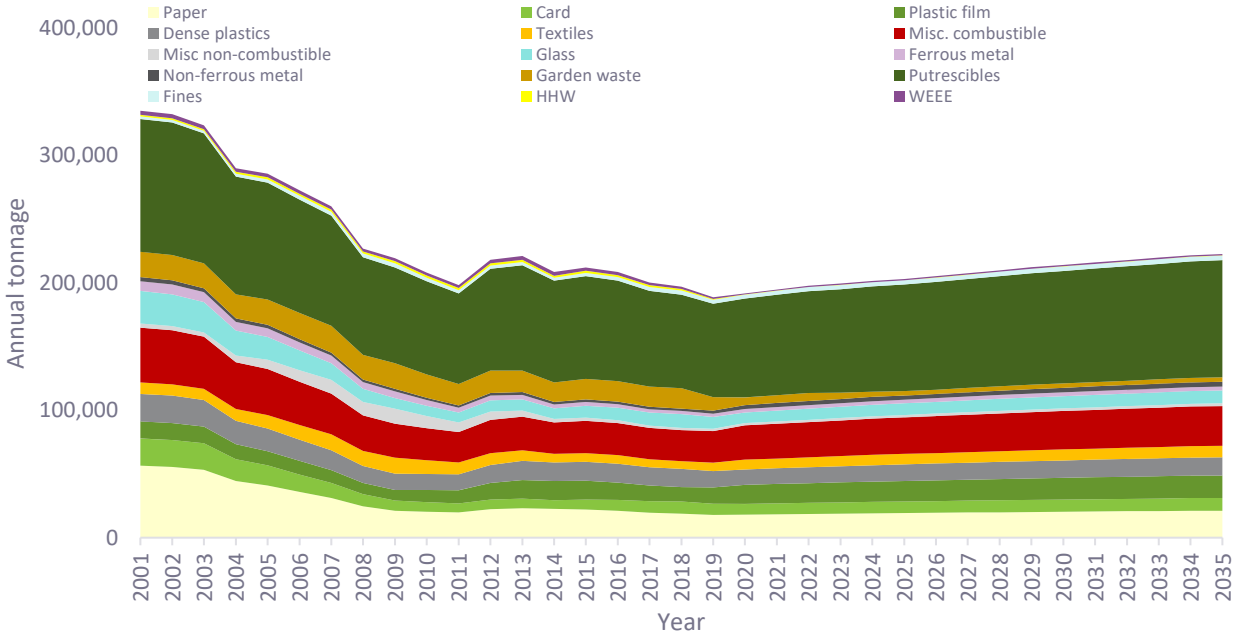
5.3.61 Figure 5.40 disaggregates the net kerbside recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure 5.40 Option 8 - High level net kerbside recycling composition



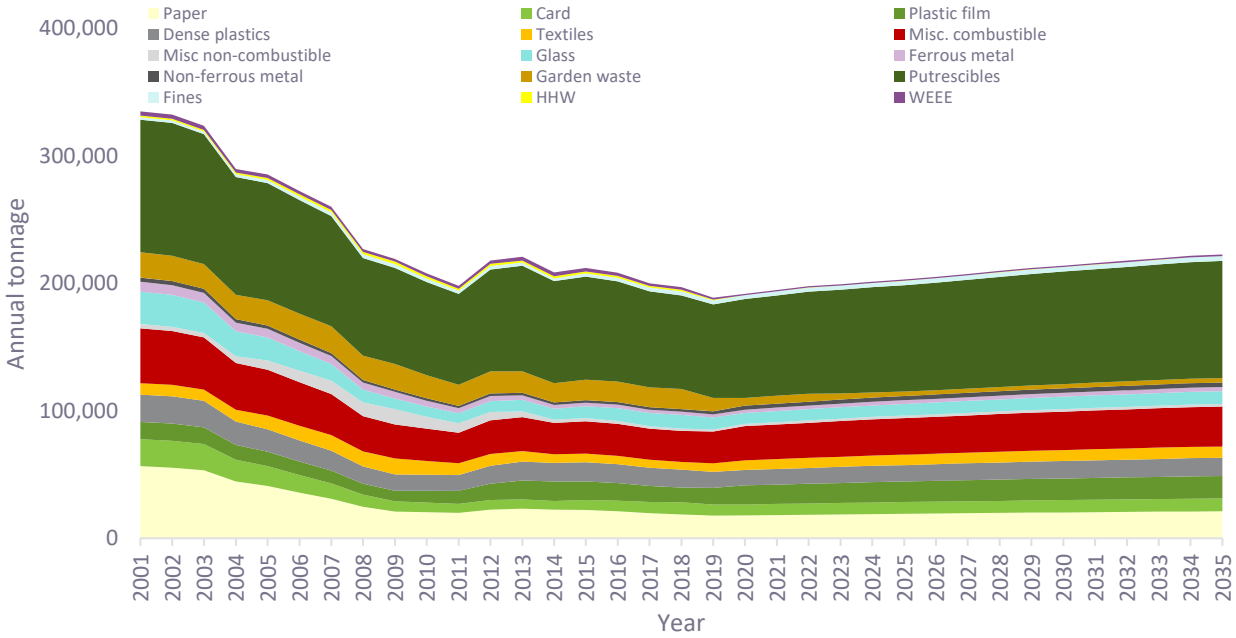
5.3.62 Figure 5.41 disaggregates the total collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.41 Option 8 - Total collected household residual waste composition



5.3.63 Figure 5.42 disaggregates the Kerbside collected residual waste stream into its component categories. This illustrates the historical and projected variation in material tonnage collected by the authority using this option.

Figure 5.42 Option 8 - Kerbside collected residual waste composition



5.3.64 If the Authority/Councils were to implement the measures identified under option 8, the recycling rate achieved would be as presented in Table 5.7. The Authority's recycling rate is the mean across the Councils.

Table 5.7 Option 8 recycling rate for the Authority and Councils

KPI	WRWA	H&F	RBKC	Lambeth	Wandsworth
Recycling rate	27%	27%	28%	32%	23%

5.3.65 The recycling rate increases by approximately 2% for H&F and Wandsworth compared to the baseline as these Councils do not currently operate a garden waste collection. There is a slight increase in the recycling rate for Lambeth and RBKC as these Councils already implement a garden waste service (model assumes a small uptake in garden waste collected).

5.4 Resource and cost assessment

5.4.1 The cost and resource modelling focusses on options 3, 7 and 8; it was agreed with the Authority that a high-level collections assessment would be carried out for these options due to the impact the service changes under these options would have on resources and costs for the Councils. The assessment was based on the household collected waste and non-household collected waste service for kerbside residual waste and the household collected waste service for kerbside recycling.

5.4.2 The cost model utilised key service information to produce a strategic cost assessment of the options and has been based on data provided by each Council. Where data has not been provided, assumptions based on industry experience have been made, as agreed by the Authority.

5.4.3 In the following section, the options have been compared to the projected baseline at the year 2030, by which time, costs associated with infrastructure investment are in place and the service has been fully established.

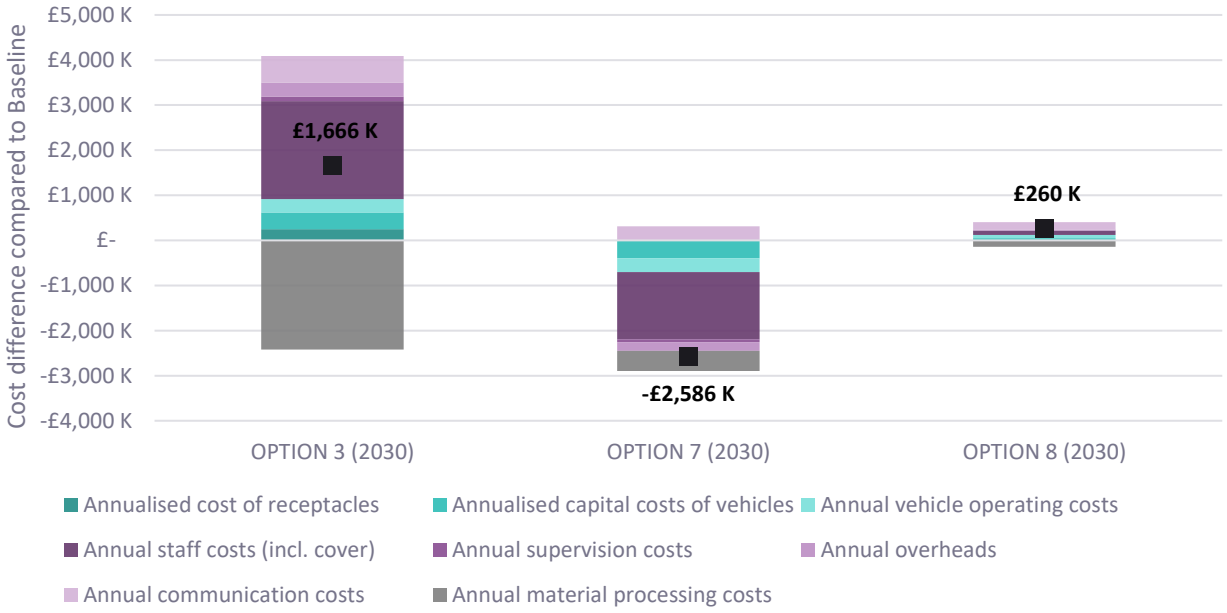
5.4.4 In all instances, option 3 comes out as the most expensive option. This is largely due to the greater cost associated with running a food waste service such as the cost to run several extra vehicles. However, the government is considering allocating funding for separately collected food waste as part of the Resource and Waste strategy so there may be some fiscal support available to offset these costs. A dedicated food waste service does however save on some operating costs. Less weight in the refuse vehicle corresponds to fewer requirements to tip which allows a more efficient residual waste service. Furthermore, costs can be recovered through material processing.

5.4.5 Where the overall cost per tonne for waste managed under these options is presented, it should be noted that these figures indicate the scale of difference between the options and does not constitute a budget level calculation of costs for the delivery of the service.

Western Riverside Waste Authority

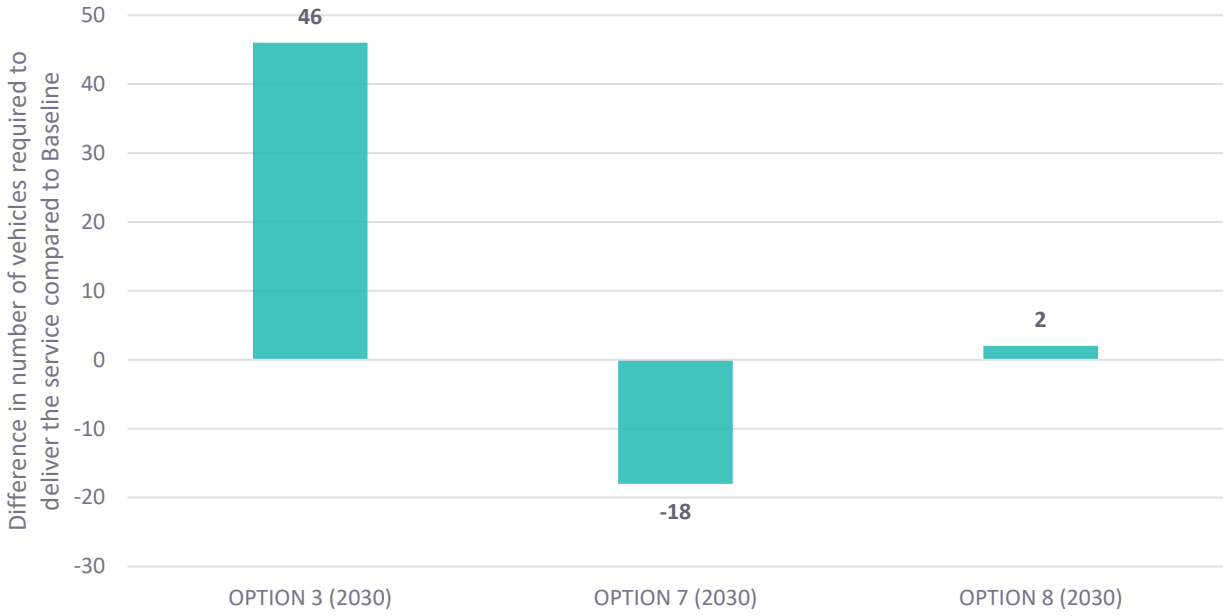
5.4.6 Figure 5.43 compares the costs associated with options 3, 7 and 8 against the baseline costs projected to 2030 for the authority area. It further disaggregates the costs by service provision. This includes the annual material processing costs, e.g. gate fees, which are a cost to the Authority being the disposal authority.

Figure 5.43 Cost comparison for the Authority against the baseline projected to 2030.



5.4.7 Figure 5.44 presents the vehicles required to deliver options 3, 7 and 8 against the vehicles required to deliver the baseline projected to 2030 for the authority area.

Figure 5.44 Comparison of vehicles required by the Authority for each option against the baseline projected to 2030.



5.4.8 The cost outputs suggest that option 3 is the most expensive option – costing the authority £1.67 million more than the projected baseline. However, this only represents an increase of about 3% of the baseline service cost projected to 2030.

5.4.9 Option 7 provides a saving of about £2.59 million on the baseline projected to 2030, which is an approx. 4% decrease on the baseline costs. Option 8 incurs a small increase in cost of approx. £260 thousand on the baseline projected to 2030. This is an increase of less than 1% compared to the baseline costs.

5.4.10 The overall cost per tonne for waste managed under these options can be found in Table 5.8.

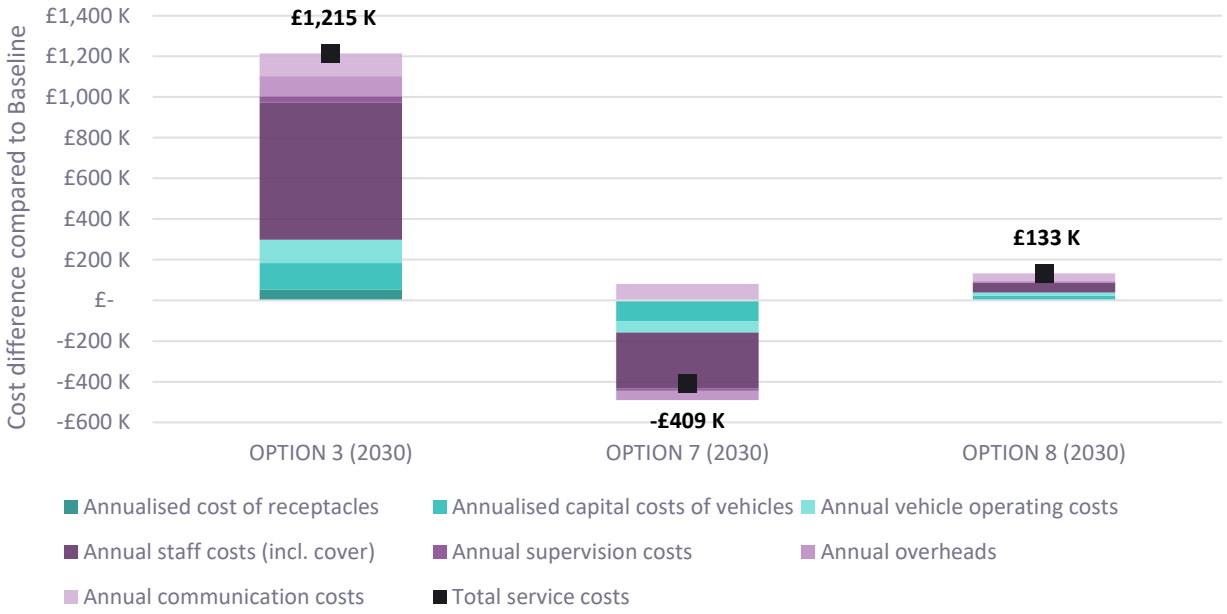
Table 5.8 Authority cost per tonne for options 3, 7 and 8

KPI	Baseline	Option 3	Option 7	Option 8
Cost per tonne	£178.27	£182.32	£171.06	£177.96

Hammersmith & Fulham

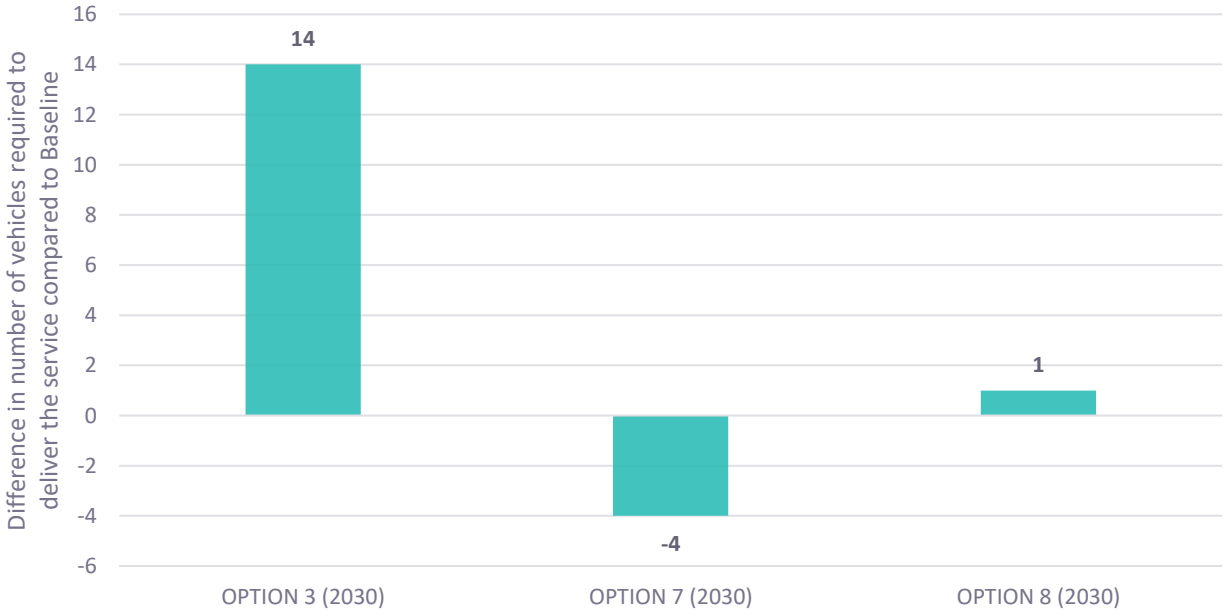
5.4.11 Figure 5.45 compares the costs associated with options 3, 7 and 8 against the baseline costs projected to 2030 for Hammersmith and Fulham. It further disaggregates the costs by service provision.

Figure 5.45 Cost comparison for Hammersmith & Fulham against the baseline projected to 2030.



5.4.12 Figure 5.46 compares the vehicles required to deliver options 3, 7 and 8 against the vehicles required to deliver the baseline projected to 2030 for H&F.

Figure 5.46 Comparison of vehicles required by Hammersmith & Fulham for each option against the baseline projected to 2030.



5.4.13 The cost outputs suggest that option 3 is the most expensive option – costing Hammersmith & Fulham Council £1.22 million more than the projected baseline. This represents an increase of about 31% of the baseline service cost projected to 2030.

5.4.14 Option 7 provides a saving of about £409 thousand on the baseline projected to 2030. This is an approx. decrease of 10% on the baseline costs. Option 8 incurs a small increase in cost of approx.

£133 thousand on the baseline projected to 2030. This is an increase of around 3% on the baseline costs.

5.4.15 The overall cost per tonne for waste managed under these options can be found in Table 5.9.

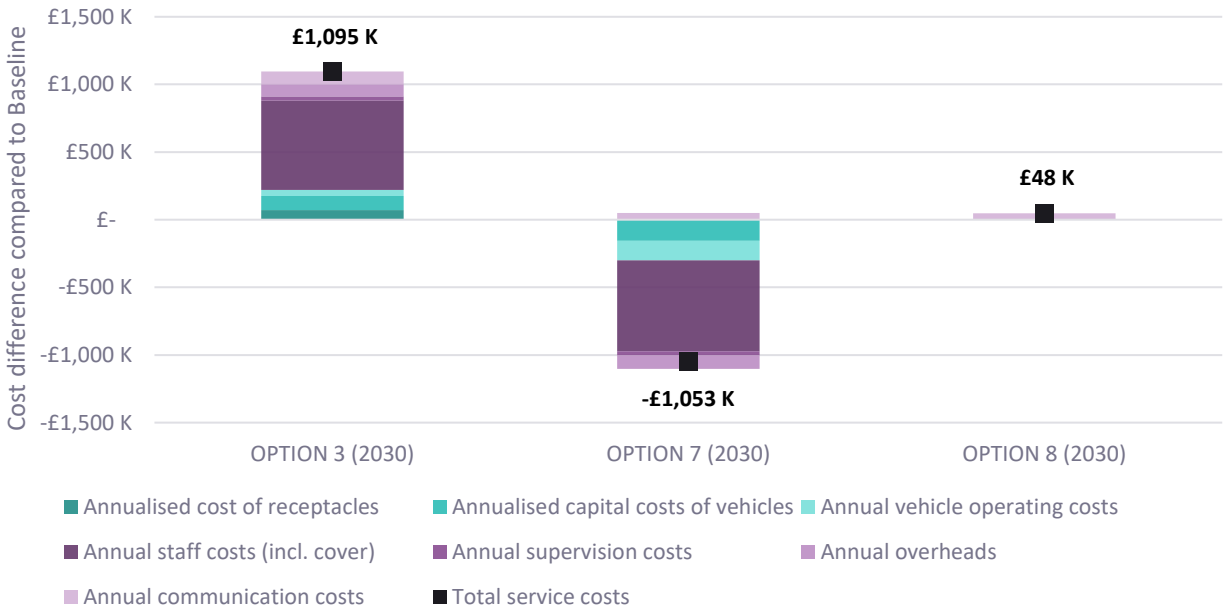
Table 5.9 H&F cost per tonne for options 3, 7 and 8

KPI	Baseline	Option 3	Option 7	Option 8
Cost per tonne	£50.82	£66.43	£45.46	£52.26

Royal Borough of Kensington & Chelsea

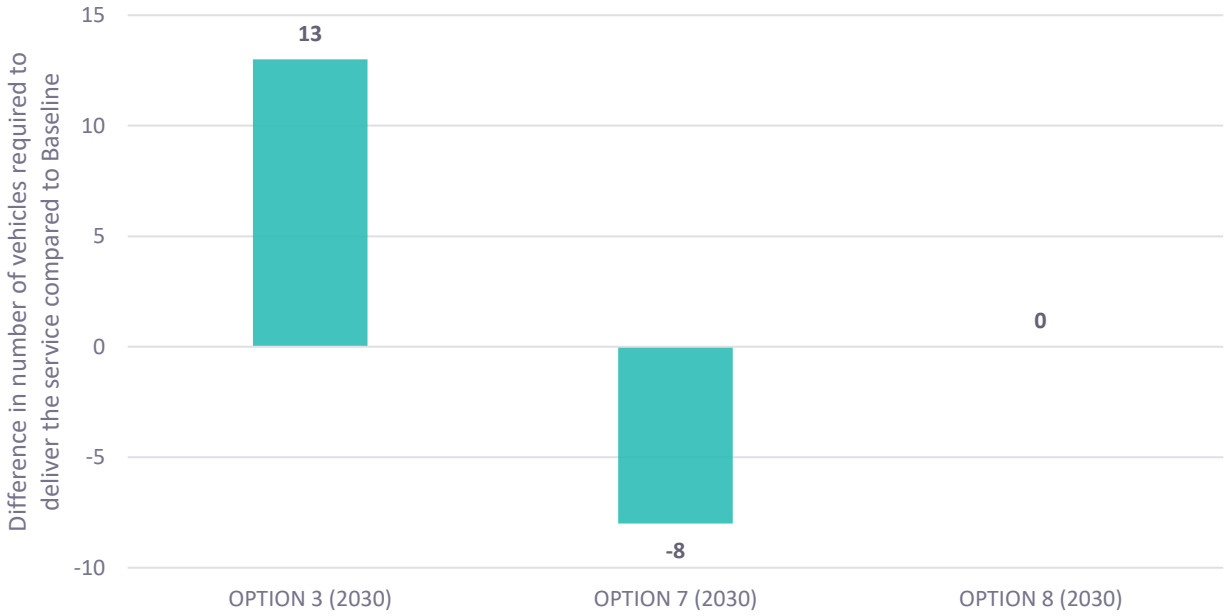
5.4.16 Figure 5.47 compares the costs associated with options 3, 7 and 8 against the baseline costs projected to 2030 for RBKC. It further disaggregates the costs by service provision.

Figure 5.47 Cost comparison for the Royal Borough of Kensington & Chelsea against the baseline projected to 2030.



5.4.17 Figure 5.48 compares the vehicles required to deliver options 3, 7 and 8 against the vehicles required to deliver the baseline projected to 2030 for RBKC.

Figure 5.48 Comparison of vehicles required by the Royal Borough of Kensington & Chelsea for each option against the baseline projected to 2030.



5.4.18 The cost outputs suggest that option 3 is the most expensive option – costing the Royal Borough of Kensington & Chelsea Council £1.10 million more than the projected baseline. This represents an increase of about 20% of the baseline service cost projected to 2030.

5.4.19 Option 7 provides a saving of about £1.05 million on the baseline projected to 2030. This is about 19% of the baseline costs. Option 8 incurs a small increase in cost of about £48 thousand on the baseline projected to 2030. This is an increase of around 1% on the baseline costs.

5.4.20 The overall cost per tonne for waste managed under these options can be found in Table 5.10.

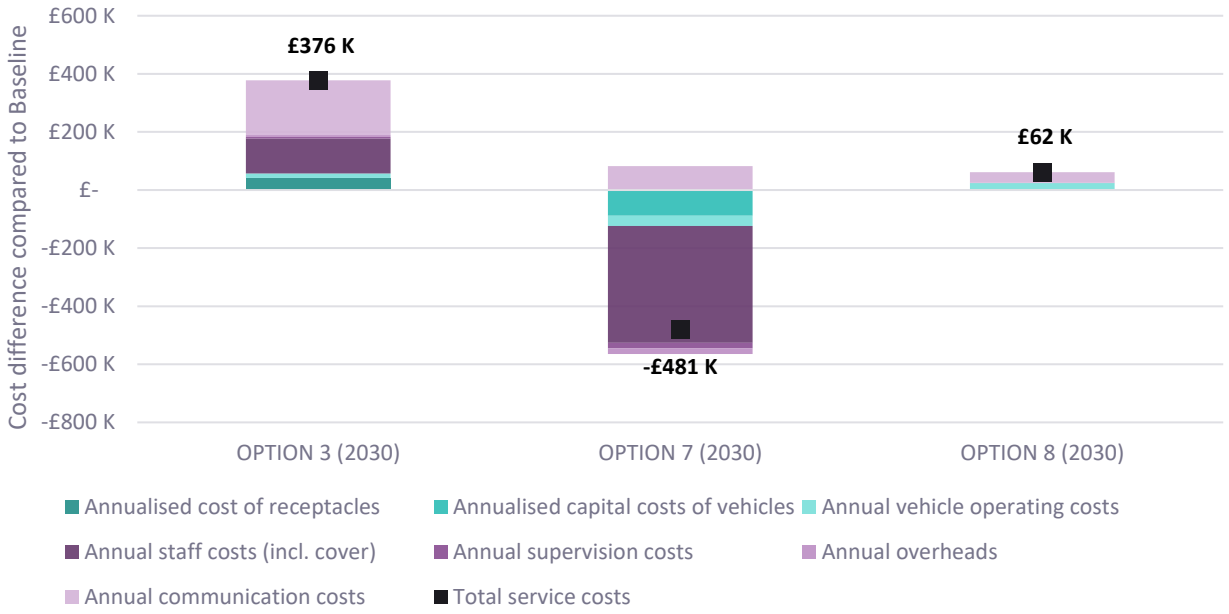
Table 5.10 RBKC cost per tonne for options 3, 7 and 8

KPI	Baseline	Option 3	Option 7	Option 8
Cost per tonne	£77.85	£92.69	£62.98	£78.29

Lambeth

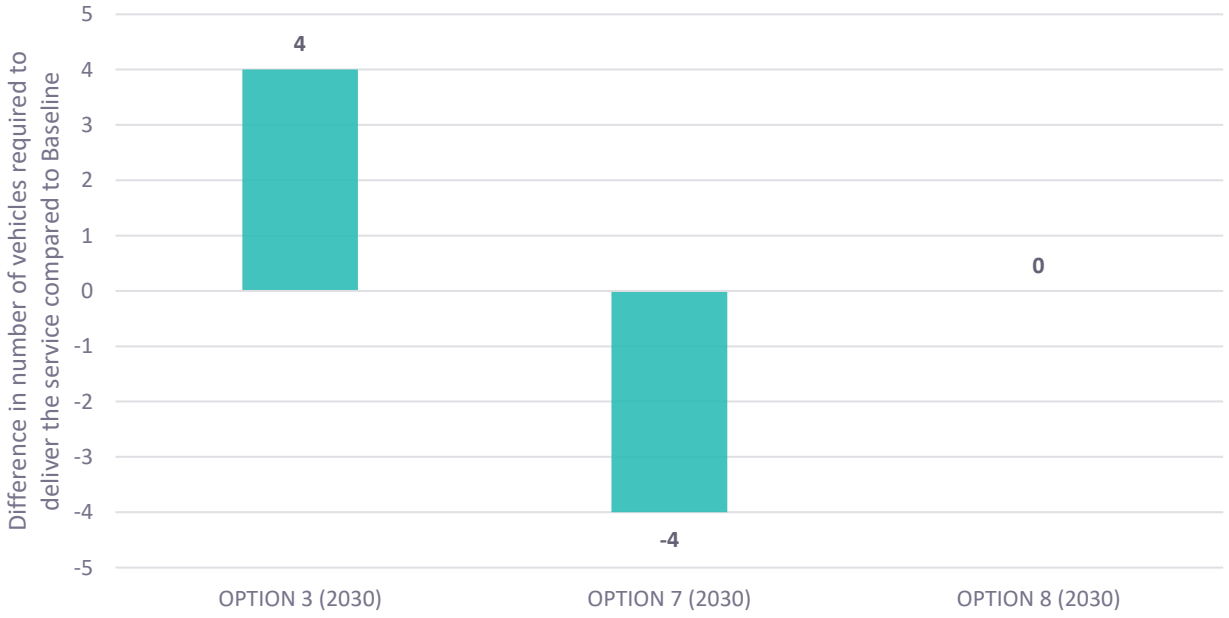
5.4.21 Figure 5.49 compares the costs associated with options 3, 7 and 8 against the baseline costs projected to 2030 for Lambeth. It further disaggregates the costs by service provision.

Figure 5.49 Cost comparison for Lambeth against the baseline projected to 2030.



5.4.22 Figure 5.50 compares the vehicles required to deliver options 3, 7 and 8 against the vehicles required to deliver the baseline projected to 2030 for Lambeth.

Figure 5.50 Comparison of vehicles required by Lambeth for each option against the baseline projected to 2030.



5.4.23 The cost outputs suggest that option 3 is the most expensive option – costing Lambeth Council £376 thousand more than the projected baseline. This represents an increase of about 8% of the baseline service cost projected to 2030.

5.4.24 Option 7 provides a saving of about £481 thousand on the baseline projected to 2030. This is about 10% of the baseline costs. Option 8 incurs a small increase in cost of about £62 thousand on the baseline projected to 2030. This is around 1% of the baseline costs.

5.4.25 The overall cost per tonne for waste managed under these options can be found in Table 5.11.

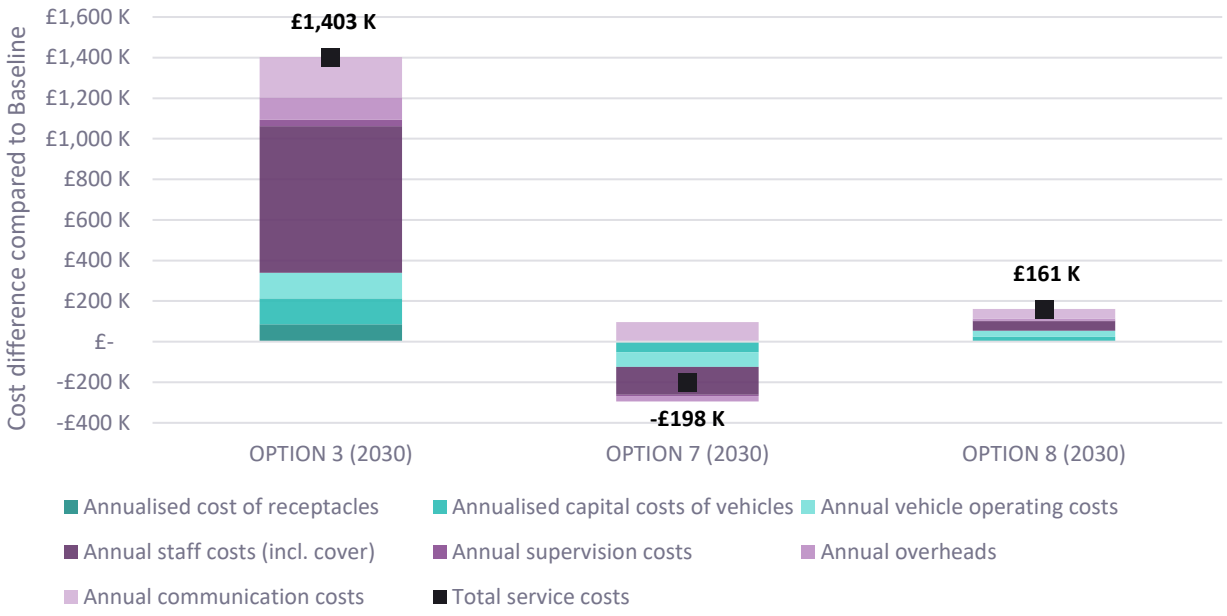
Table 5.11 Lambeth cost per tonne for options 3, 7 and 8

KPI	Baseline	Option 3	Option 7	Option 8
Cost per tonne	£41.80	£45.06	£37.59	£41.84

Wandsworth

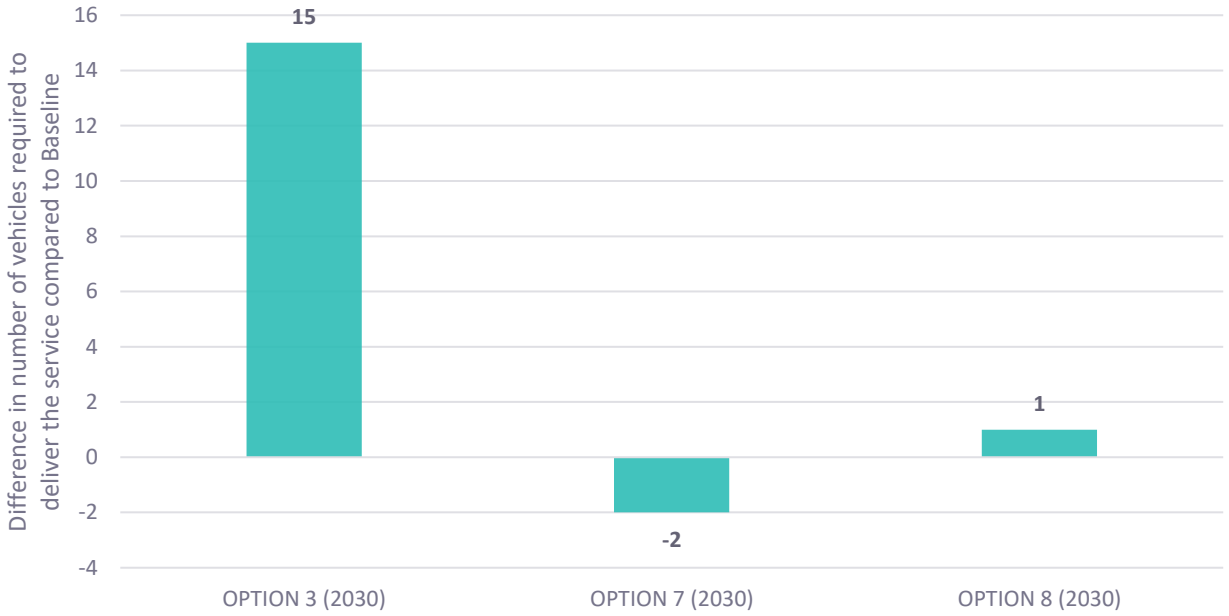
5.4.26 Figure 5.51 compares the costs associated with options 3, 7 and 8 against the baseline costs projected to 2030 for Wandsworth. It further disaggregates the costs by service provision.

Figure 5.51 Cost comparison for Wandsworth against the baseline projected to 2030.



5.4.27 Figure 5.52 compares the vehicles required to deliver options 3, 7 and 8 against the vehicles required to deliver the baseline projected to 2030 for Wandsworth.

Figure 5.52 Comparison of vehicles required by Wandsworth for each option against the baseline projected to 2030.



5.4.28 The cost outputs suggest that option 3 is the most expensive option – costing Wandsworth Council £1.40 million more than the projected baseline. This represents an increase of about 31% of the baseline service cost projected to 2030.

5.4.29 Option 7 provides a saving of about £198 thousand on the baseline projected to 2030. This is about 4% of the baseline costs. Option 8 incurs a small increase in cost of approx. £161 thousand on the baseline projected to 2030. This is an increase of around 4% on the baseline costs.

5.4.30 The overall cost per tonne for waste managed under these options can be found in Table 5.12.

Table 5.12 Wandsworth cost per tonne for options 3, 7 and 8

KPI	Baseline	Option 3	Option 7	Option 8
Cost per tonne	£41.80	£45.06	£37.59	£41.84

5.5 Carbon modelling

5.5.1 Wood has assessed the carbon impact of the modelled options to illustrate potential future emissions of the Authority's and its constituent Councils' waste management activities using WRATE.

5.5.2 Within the WRATE carbon results the lower the number the better with negative numbers representing an overall reduction in atmospheric carbon equivalent emissions. When considering the environmental impact of these options it should be borne in mind that WRATE does not effectively represent the benefits associated with waste reduction and in particular when considering the impact of waste reduction into facilities utilising other waste sources, in this instance due to the WRATE project boundaries it assumes that the waste into the facilities reduces when in reality additional waste will be sourced from other suppliers, typically drawing in C&I waste which would have been landfilled reducing the carbon impact. For this reason, we have excluded

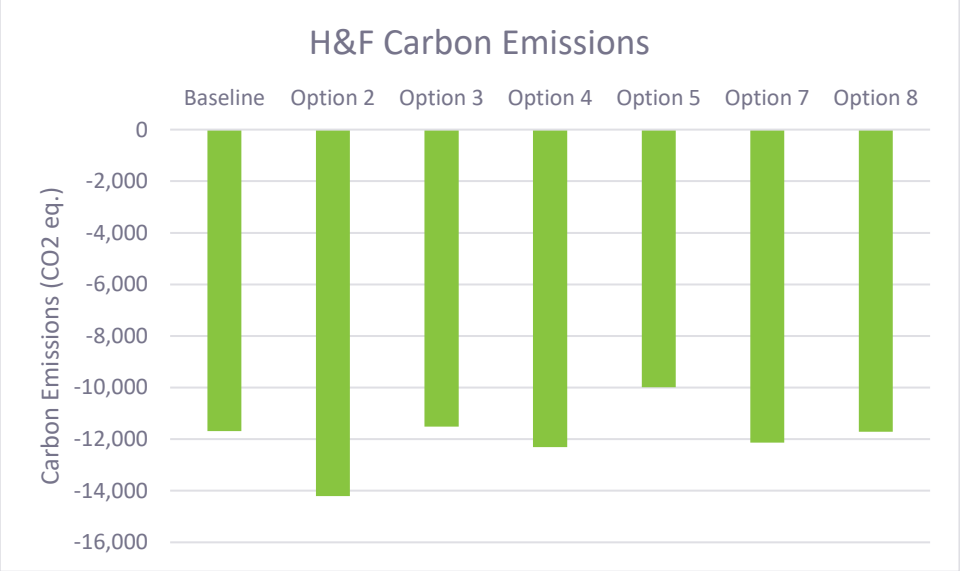
option 1 results from the following sections, In addition WRATE tends to underestimate the environmental benefits associated with the recycling of textiles.

5.5.3 The WRATE software does not currently allow for the assessment of the impact of electric collection vehicles therefore we have had to estimate the impact based on information we have obtained from suppliers. We have used this to estimate the impact on the collection emissions (approximately 75% reduction in emissions) and hence the overall carbon impact of the solution for option 6.

Hammersmith & Fulham

5.5.4 Figure 5.53 shows the overall carbon equivalent emissions for each option for Hammersmith and Fulham. The results indicate that Option 2 (increasing recycling rates) leads to the lowest carbon impact with Options 4 (Textiles recycling) and 7 (AWC) and 8 (separate Garden Waste) also providing additional benefits.

Figure 5.53 Comparison of total carbon equivalent emissions for each option in H&F.



5.5.5 Table 5.13 shows the emissions break down associated with each of the options, from this analysis it is clear that the impact of recycling and waste treatment have the most significant impacts on waste service carbon emissions.

Table 5.13 Breakdown of carbon equivalent emissions for each option for H&F

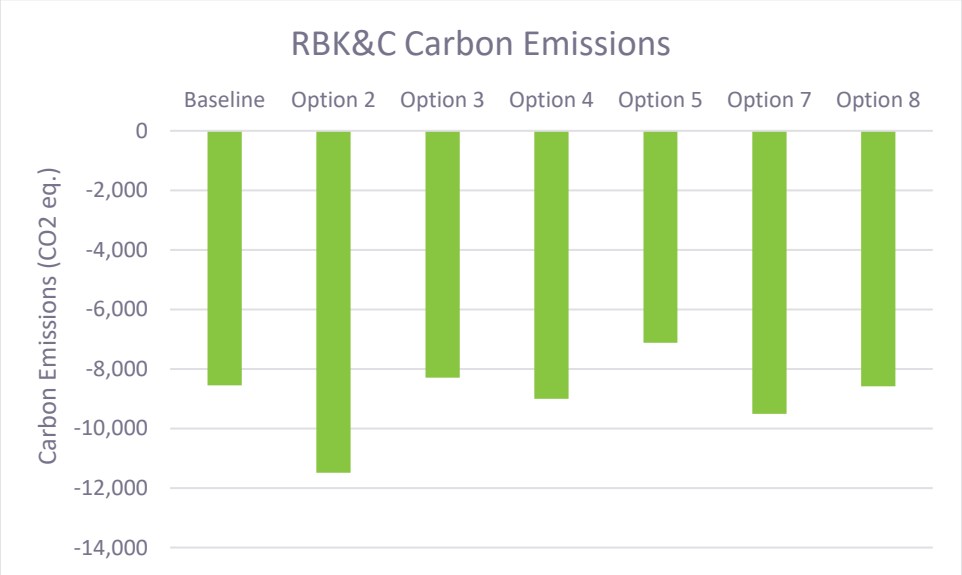
	Baseline	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Containers	300	320	327	300	300	300	300	300
Waste Collection	368	439	439	368	368	94	350	352
WTS & MRF	176	172	175	176	162	176	175	175
Recycling	-13,544	-15,678	-13,704	-14,138	-11,540	-13,544	-14,010	-13,555

	Baseline	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Treatment (EfW/AD/IVC)	1,006	538	1,243	986	717	1,006	1,040	1,007
Landfill	5	4	4	5	4	5	4	5
Total	**-11,689**	**-14,205**	**-11,516**	**-12,303**	**-9,989**	**-11,936**	**-12,140**	**-11,716**

Royal Borough of Kensington & Chelsea

5.5.6 Figure 5.54 shows the overall carbon equivalent emissions for each option for the Royal Borough of Kensington and Chelsea. The results indicate that Option 2 (increasing recycling rates) leads to the lowest carbon impact with Options 4 (Textiles recycling), 7 (AWC) and 8 (separate Garden Waste) also providing additional benefits.

Figure 5.54 Comparison of total carbon equivalent emissions for each option in RBK&C.



5.5.7 Table 5.14 shows the emissions break down associated with each of the options, from this analysis it is clear that the impact of collections, recycling and waste treatment have the most significant impacts on waste service carbon emissions.

Table 5.14 Breakdown of carbon equivalent emissions for each option for RBK&C

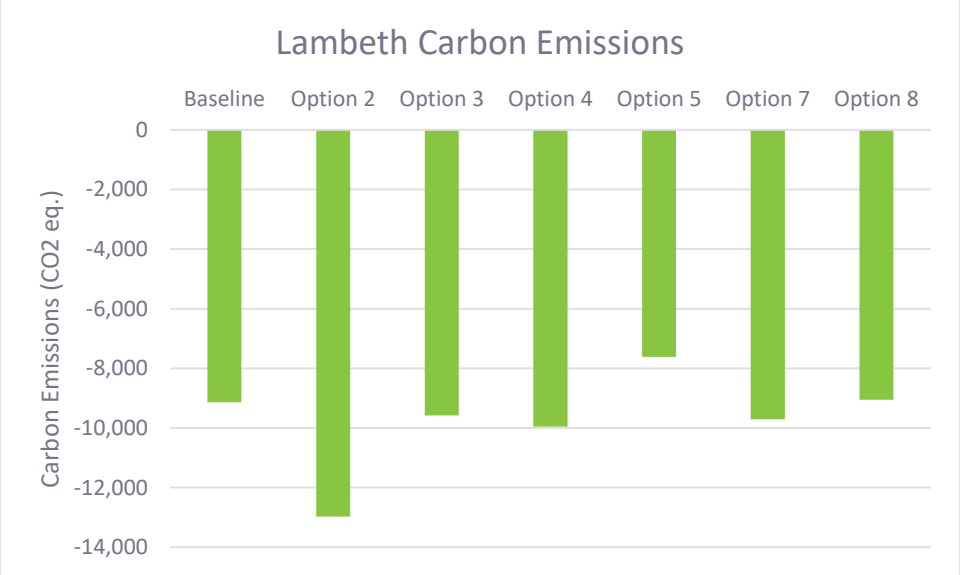
	Baseline	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Containers	338	360	360	338	338	338	338	338
Collections	1,067	1,251	1,252	1,067	1,067	169	337	1,025
Intermediate Facilities	157	155	157	157	143	157	157	157
Recycling	-11,286	-14,028	-11,409	-11,743	-9,397	-11,286	-11,592	-11,305

	Baseline	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Treatment	1,166	775	1,348	1,170	722	1,166	1,251	1,197
Landfill	4	3	4	4	4	4	4	4
Total	**-8,554**	**-11,485**	**-8,290**	**-9,007**	**-7,124**	**-9,452**	**-9,506**	**-8,584**

Lambeth

5.5.8 Figure 5.55 shows the overall carbon equivalent emissions for each option for Lambeth. The results indicate that Option 2 (increasing recycling rates) leads to the lowest carbon impact with Options 4 (Textiles recycling), 3 (food waste to AD) and 7 (AWC) also providing additional benefits. AD treatment of food waste has a greater carbon benefit than IVC due to the associated production of electricity, which is reflected in Lambeth's respective carbon emissions (Baseline IVC vs Option 3 AD).

Figure 5.55 Comparison of total carbon equivalent emissions for each option in Lambeth.



5.5.9 Table 5.15 shows the emissions break down associated with each of the options, from this analysis it is clear that the impact of collections, recycling and waste treatment have the most significant impacts on waste service carbon emissions.

Table 5.15 Breakdown of carbon equivalent emissions for each option for Lambeth

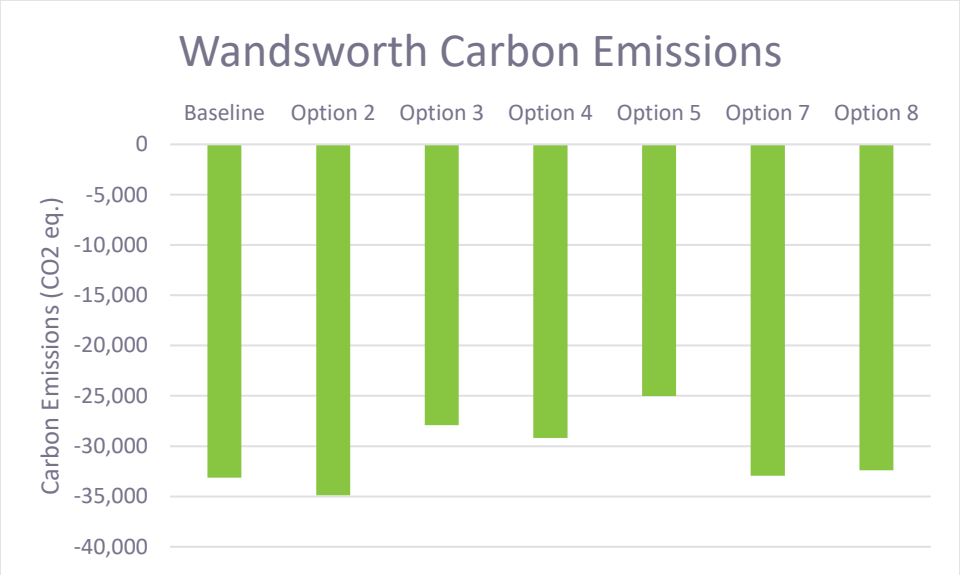
	Baseline	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Containers	566	566	566	566	566	566	566	566
Collections	932	1,080	1,081	932	932	237	457	973
Intermediate Facilities	245	245	248	245	228	245	244	244
Recycling	-12,949	-16,383	-12,927	-13,741	-11,238	-12,949	-13,155	-12,918

	Baseline	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Treatment	2,063	1,516	1,451	2,037	1,896	2,063	2,171	2,080
Landfill	6	5	5	6	5	6	5	6
Total	**-9,138**	**-12,971**	**-9,576**	**-9,956**	**-7,611**	**-9,832**	**-9,712**	**-9,050**

Wandsworth

5.5.10 Figure 5.56 shows the overall carbon equivalent emissions for each option for Wandsworth. The results indicate that Option 2 (increasing recycling rates) leads to the lowest carbon impact with Options 4 (Textiles recycling) and 7 (AWC) also providing additional benefits.

Figure 5.56 Comparison of total carbon equivalent emissions for each option in Wandsworth.



5.5.11 Table 5.16 shows the emissions break down associated with each of the options, from this analysis it is clear that the impact of recycling and waste treatment have the most significant impacts on waste service carbon emissions.

Table 5.16 Breakdown of carbon equivalent emissions for each option for Wandsworth

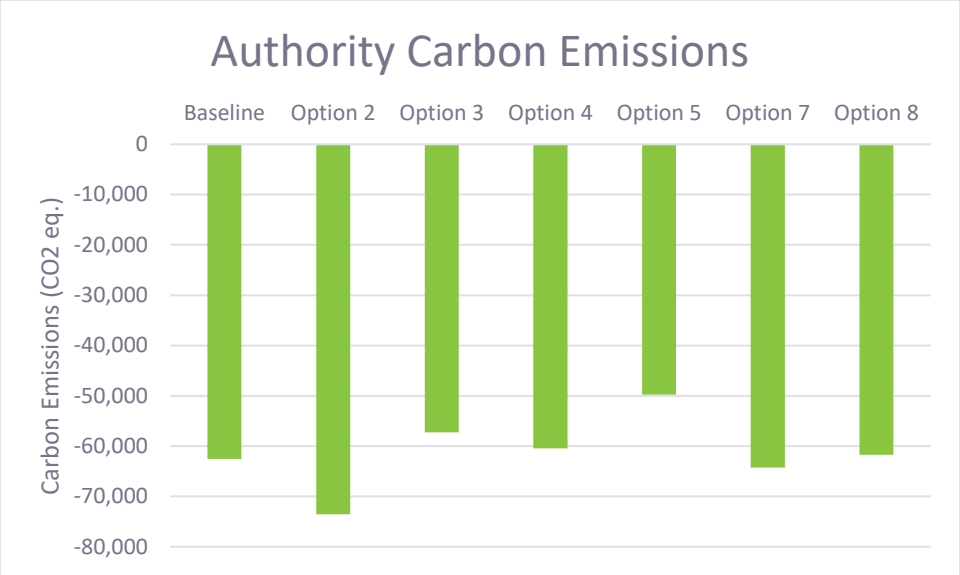
	Baseline	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Containers	536	570	570	536	536	536	536	536
Collections	1,027	1,275	1,276	1,025	1,025	263	951	1,054
Intermediate Facilities	399	303	310	310	295	399	398	399
Recycling	-34,838	-36,712	-32,343	-32,967	-28,400	-34,838	-34,956	-34,607
Treatment	-279	-319	2,263	1,895	1,526	-279	135	215
Landfill	10	6	8	8	8	10	10	10

	Baseline	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Total	**-33,145**	**-34,876**	**-27,916**	**-29,193**	**-25,010**	**-33,909**	**-32,925**	**-32,393**

Western Riverside Waste Authority

5.5.12 Figure 5.57 shows the overall carbon equivalent emissions for each option for the Authority. The results indicate that Option 2 (increasing recycling rates) leads to the lowest carbon impact with Options 4 (Textiles recycling) and 7 (AWC) also providing additional benefits.

Figure 5.57 Comparison of total carbon equivalent emissions for each option across the Authority.



5.5.13 Table 5.17 shows the emissions break down associated with each of the options, from this analysis it is clear that the impact of collections, recycling and waste treatment have the most significant impacts on waste service carbon emissions.

Table 5.17 Breakdown of carbon equivalent emissions for each option for the Authority

	Baseline	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Containers	1,740	1,815	1,823	1,740	1,740	1,740	1,740	1,740
Collections	3,394	4,046	4,048	3,392	3,391	763	2,095	3,403
Intermediate Facilities	976	875	890	887	827	976	974	975
Recycling	-72,616	-82,801	-70,383	-72,589	-60,574	-72,616	-73,713	-72,385
Treatment	3,955	2,510	6,304	6.088	4,861	3,955	4,596	4,499
Landfill	24	18	21	22	21	24	24	24
Total	**-62,526**	**-73,537**	**-57,297**	**-60,460**	**-49,734**	**-65,157**	**-64,283**	**-61,743**

5.5.14 The Authority is interested in the potential impact of treating organic waste (and food waste in particular) waste within EfW and AD facilities. A direct statement of the impact is difficult to make because the boundaries of the assessment. Comparing option 3 with the baseline indicates the overall position for the Authority (including the collection of the food waste) and suggests that the net position is worse for the environment by approximately 5,200Tpa CO2 eq. The reduction in EfW benefit of removing the food waste in option 3 is approximately 4,200Tpa CO2 eq, if this benefit were to be incorporated into assessment the impact would be only 1,000Tpa CO2 eq worse.

5.5.15 The Authority is interested in the potential carbon savings associated with the introduction of CHP at the Riverside EfW facility. The benefit associated with the introduction of heat at the EfW facility will depend specifically upon the ratio of heat recovery to electricity production, the energy source replaced and the users supplied. A sensitivity analysis has been undertaken to identify the impact of introducing heat recovery at the EfW facility based upon reducing the electricity generation by 5% to supply heat to a large industrial user offsetting mixed energy. This scenario would result in additional carbon savings of approximately 4,000Tpa for every 5% reduction in electricity production due to additional heat offtake.

5.6 Options Summary

5.6.1 The waste flow modelling, resource and cost assessment and carbon modelling illustrate to the Authority and the constituent Councils the impact implementing the various options will have in terms of waste composition and tonnages, recycling rate, costs to manage the waste (for selected options) and the associated carbon emissions. Table 5.18 presents a summary for the Authority against the KPIs. Percentage differences on the baseline are provided for total GHG emissions per household for each option.

Table 5.18 Option KPI summary

KPI	Baseline	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Recycling rate	25%	25%	38%	32%	26%	22%		27%	27%
Waste minimisation (against the baseline)		72,408t				22,216t			
Cost per tonne of waste	£178.27			£182.32				£171.06	£177.96
Vehicle GHG emissions (T)	3,394	3,388	4,046	4,048	3,392	3,391	763	2,095	3,403
Total GHG emissions per household (KG/HH)	-117.3 (basis)	-	-137.9 (17.8%)	-107.5 (-8.4%)	-113.4 (-3.3%)	-93.3 (-20.5%)	-123.1 (5.0%)	-120.6 (2.8%)	-115.8 (-1.3%)

5.6.2 It is clear that options 2 and 3 have the greatest impact on recycling rate. Option 3 however, has an increased cost per tonne associated with implementing a dedicated food waste service Authority wide, as well an increase in carbon emissions in comparison to the baseline. Option 7 and 8 result

in a slight increase on the recycling rate and a decrease in the cost per tonne of managed, in particular for option 7.

5.6.3 Option 1 and 5 result in a reduction of waste against the baseline as the measures implemented under these options target specific materials for reduction. Option 1 targets food waste, single use plastics and paper and results in a 23% tonnage decrease in comparison to the baseline, at the Authority level.

5.6.4 Vehicle GHG emissions are based on diesel vehicles for all options apart from option 6 which utilises electric vehicles. There is a marked reduction in GHG emissions (approx. 75%) under this option illustrating where efforts could be targeted where the ultimate aim is to reduce GHG.

5.6.5 Option 2 overall has the lowest carbon emissions per household with a decrease of almost 18%, due to the increased quantities of dry recyclables collected and recycled, and illustrates the carbon emissions that can be saved when recycling is maximised.

5.6.6 Options 3, 4, 5 and 8 result in an overall increase in carbon equivalent emissions with option 5 resulting in an increase of more than 20% as a result of recyclable materials (drinks packaging) being taken out of the constituent councils kerbside recycling waste stream. The environmental benefit will simply switch to the DRS scheme, but society will benefit overall from the additional materials DRS removes from the residual waste stream.

5.6.7 Option 3 generates greater emissions per household in comparison to the baseline at the Authority level, as a result of food waste being collected separately and treated at an AD plant as opposed to being mixed in with residual waste and being treated at an EfW. For Lambeth, however, this resulted in an improved carbon performance as food waste is currently treated at an IVC.

5.6.8 Option 1 generated the worst GHG emissions of all of the options but WRATE is not effective at modelling waste minimisation so the results have been excluded from the table. Waste minimisation is however recognised as being a better environmental option and resulting in lower carbon impacts however the basis for these assessments is outside the scope of the WRATE model.

5.6.9 It is important to emphasise that there are differences in the carbon outcomes of the different options across the constituent councils dependant on their waste composition and existing service provision.

5.6.10 The Authority and its constituent Councils need to consider the results of this project as well as overall budget and specific priorities to determine which option, or options, would be best implemented to deliver improvements in environmental performance. If a combination of options were implemented, the results cannot be interpreted proportionately as the overall impact would depend on waste composition, tonnages and current service arrangements.

6. Carbon management and strategy

6.1.1 All of the Councils have declared a climate emergency and have a target to be carbon neutral by 2030.

6.1.2 When setting targets and plans to manage carbon, the Authority and the constituent Councils need to be mindful of what categories/activities they can control and have an influence over in terms of reducing carbon emissions.

6.1.3 The resources to be included in a carbon inventory are defined in relation to two boundaries: the organisational and the operational boundary. This will cover the Authority's and Council's estate/assets, services and operations over which they have operation control. Table 6.1 shows the organisation (category) and operational (emission sources) boundaries.

6.1.4 In keeping with the Greenhouse Gas Protocol[2], the operational boundary should include all Scope 1 (direct) and Scope 2 (indirect) emissions (e.g. on-site fuel combustion, company owned vehicles and purchased electricity consumption). Scope 3 emissions (e.g. waste (produced by the business), water, commuting and business travel) are considered discretionary but are included where data is available.

6.1.5 As the Authority does not operate any of it's facilities, e.g. HWRC, MRF, EfW, then these fall outside of the boundaries as assets the Authority can directly control. The waste the residents produce is also technically outside of the Councils' control as they do not have direct influence over the residents' actions when it comes to waste management. However the Authority/Councils are allowed to enforce their service as set out in Section 46 of the Environmental Protection Act 1990 EPA, which prohibits certain recyclable materials within the black wheelie bin for which alternative collections are supplied.

Table 6.1 Carbon organisation and operational boundaries

Category	Emission source
Offices	Electricity, gas, water, waste, material use
Workshops	Electricity, gas, water, waste, material use
Fleet	Fuel, business miles
Containers	Numbers, material use

6.1.6 As mentioned in section 5 in defining the options, we can see that the Councils are defining targets and setting actions to reduce their transport emissions, as follows:

- RBKC - *Work with their waste contractor to reduce emissions from its fleet and improve their operations with a target of 35% reduction versus 2007-2008.*
- Lambeth - *Put electric vehicle infrastructure in place, using low-emission vehicles when necessary. Only ultra-low emission vehicles will be able to be leased by 2022.*

[2] The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard Revised Edition, Worlds Resources Institute; World Business Council for Sustainable Development, 2015.

- Wandsworth - *Reduce emissions of vehicle fleet with a roll out of low emission fleet vehicles with a plan for all Council vehicles to be powered by electric or renewable fuel sources by 2030.*

6.1.7 Identifying SMART targets for the delivery of the actionable options is not considered to be appropriate at this time as they involve alterations to service contracts or significant capital expenditure which would need to be considered within a detailed Cost Benefit Analysis (CBA) with reference to the Councils budget provisions, procurement schedules and strategic aims. Upon completion of these actions a schedule for the implementation of schemes could be developed against which SMART targets can be allocated.

6.1.8 Wood has devised a range of carbon management actions in Table 6.2 which will allow the Authority/Councils to work towards the goal of carbon reduction with guidance as to the input that will be required to implement the initiatives. They are short/medium term actions.

6.1.9 As the carbon assessment has been made at a strategic level across the entirety of the waste service it is not possible to provide a specific carbon saving against all of the individual elements. Where this has not been possible a narrative entry has been made; further detailed investigation may be required ahead of developing specific SMART targets.

Table 6.2 Carbon management actions

Area	Steps of action	Stakeholders	Progress monitoring	Data recording/ reporting	Potential Savings
Route optimisation	Engage a route optimisation company to optimise collection rounds to determine where routes and journeys could be made more efficient and only carried out where necessary, as long as they are consistent with standards of service. As part of this, Councils could consider shared collection services.	Waste officers, waste management company, round optimisation company, drivers	Reduction in fuel use Reduction in fleet milage Reduction in vehicle numbers	Fuel consumption Fleet itinerary Round logs	Minor carbon savings depending upon existing level of optimisation
Review requirements for number of vehicles currently in use	Consider how the Councils can use existing vehicles more effectively or reduce the number of vehicles in use, and making the most efficient use of those which remain.	Waste officers, waste management company	Reduction in fuel use Reduction in vehicle numbers	Vehicle itinerary	Reduced vehicle numbers results in reduced capital carbon but minimal operational carbon impacts.
Install in-cab monitoring technology – telematics	Telematics installed on a 26t collection vehicle can (assuming engaged with and monitored) provide a gain of up to 0.5mpg (e.g. increase fuel mpg from 4mpg to 4.5mpg). Install telematics into vehicles to monitor vehicle movements and driver habitats and help identify driving behaviours and activities e.g. vehicle idling, which are leading to fuel waste. Following device feedback give training to drivers so that they improve driving to drive more fuel efficiently. More efficient driving will also reduce wear and tear on the vehicle. Telematics can also reduce mileage by locating the nearest vehicle and most appropriate driver for unplanned activities. Non-optimal routes, detours and unauthorised journeys can be detected with the device.	Telematics company, waste officers, waste management company, drivers	Reduction in fuel use Reduction in fleet milage	Fuel consumption	Up to 10% fuel (and associated Carbon) savings where the technology does not exist (RBKC, W & H&F).

Area	Steps of action	Stakeholders	Progress monitoring	Data recording/ reporting	Potential Savings
Operate greener vehicles (note mpg reduced with electric vehicles)	Review trials of electric collection vehicles (e.g. Geesinknorba trial in Cambridge 2019, Oxford trial in 2020) to confirm position on replacing the fleet with electric vehicles. See appendix E table for typical costs and emissions saved by implementing EVs. As the capital cost is currently expected to be around three times that of a conventional RCV, it may be that savings can be made on fuel (as above) and other costs in the interim, e.g. prioritise use of EVs for the management staff in waste services, although greater emissions can be saved with the larger vehicles.	Waste officers, vehicle manufacturer, Council leaders, waste management company, drivers	Number of EVs in fleet	Vehicle itinerary	Approximately 75% of collection vehicle carbon emissions (dependent upon the level of renewables in the electricity mix).
Containers	Reduce the embodied carbon used to manufacture containers. Aim for a % of recycled content when re-procuring containers. Minimise replacement rates	Waste officers, procurement, supplier	Number of containers with recycled content	Container log	Lifecycle container replacement carbon costs are likely to minimal (~174Tpa CO2 eq. for WRWA) and the savings associates with recycled materials only save a proportion of that figure.
Containers	Review container provision and reduce capacity of residual waste container if practical to encourage residents to recycle more and reduce residual waste	Waste officers, waste management contractor, residents, container supplier	Reduction in residual waste	Waste tonnages	Potential to save emissions from containers, collection and treatment if residual only is constrained.
HWRC residual waste	Consider removal of residual waste containers from HWRC – encourage residents to segregate	Waste officers, waste management contractor, residents	Reduction in residual waste	Waste tonnages	Reduced residual waste treatment and carbon impact but waste tonnages are

Area	Steps of action	Stakeholders	Progress monitoring	Data recording/ reporting	Potential Savings
	waste before visiting site to prevent black bag waste and reducer residual waste				low so limited benefit.
Food waste	Review food waste prevention activities (e.g. consider vehicle livery target messages to residents about most commonly wasted food items to reduce household waste)	Waste officers, waste management contractor, residents, schools	Reduction in residual waste	Waste tonnages	Preventing 1 tonne of (mixed) food waste saves 3,744 kg CO_2e*
Single-use plastics	Target single-use plastic reduction, e.g. campaigns, easy to use toolkit, Refill London campaign, encourage businesses to become plastic free. Aim to reduce overall waste and materials with high carbon content	Waste officers, waste management contractor, residents, businesses, Refill London (Refill Hammersmith), schools	Reduction in overall waste	Waste tonnages	Impact will depend upon replacement measures. Prevention/reuse of 1 tonne of plastic waste saves 3,189 kgCO_2e*
Home composting	Review home composting campaigns and encourage residents to home compost organic waste to reduce household waste	Waste officers, residents, local gardening communities, compost bin supplier	Reduction in residual waste	Waste tonnages	Limited reduced collection and treatment emissions.
Reuse	Consider reuse approach and develop action plan to encourage greater reuse across the Authority, e.g. bulky waste service, promotion of second-hand market	Waste officers, waste management contractor, residents, third sector organisations	Reduction in residual waste % of waste re-used	Waste tonnages	Limited reduced collection and treatment emissions.
Recycling at kerbside	Increase range of recycling at kerbside – review current materials and identify additional materials for collection as and when sustainable and cost-effective new markets develop e.g. plastic film. Communicate with residents about any changes.	Waste officers, waste management contractor, residents, landlords	Recycling rate Reduction in residual waste	Waste composition / tonnages	Up to 10,000 Tpa Carbon reduction across WRWA (option 2 outputs)

Area	Steps of action	Stakeholders	Progress monitoring	Data recording/ reporting	Potential Savings
Low recyclers	Focus on HMOs/student accommodation to improve recycling provision, best practice, Flats recycling toolkit	Waste officers, waste management contractor, residents, landlords, students, Resource London	Recycling rate	Waste composition / tonnages	Increasing recycling rates reduced carbon impacts by approx. 11KTpa
New developments	Ensure waste provisions in new developments encourage recycling	Waste officers, waste management contractor, residents, property developer, planning officers	Recycling rate	Waste composition / tonnages	Reduced residual waste treatment costs (and associated carbon emissions).
Buildings	Sustainably retrofit - improve the EPC of all service related buildings to an average level of EPC B.	Authority/Council leaders, facilities management	Energy use	EPC certificate	Minimal amount from Interim facility impacts
Energy use	Reduce energy consumption in office and depot accommodation	Authority/Council leaders, facilities management, staff	Energy use		Minimal amount from Interim facility impacts
Facilities	Improve efficiency of waste management facilities – MRF, EfW, heat take off at EfW	Waste officers, waste management contractors, supply chain	Facility efficiency	Performance certificates	Minimal amount from Facility impacts

* Figures taken from Annex 3. 2016 Carbon factors for waste, in Zero Waste Scotland 2016 Carbon metric technical report[3]

[3] Zero Waste Scotland (2018) 2016 Carbon metric technical report (Online) Available: https://www.zerowastescotland.org.uk/sites/default/files/2016%20Carbon%20Metric%20Technical%20Report.pdf

7. Conclusion

7.1.1 Several options have been modelled to determine what the Authority and its constituent Councils might focus on to best lessen any future carbon impact.

7.1.2 The carbon modelling results indicate that Option 2 (increasing recycling rates) leads to the lowest carbon impact with option 6 (electric vehicles) and option 7 (AWC) also providing additional benefits. Option 3 (food waste recycling) has an increased carbon impact in comparison to the baseline at the Authority level. The emissions break down associated with each of the options, illustrates that the impact of recycling and waste treatment have the most significant impacts on waste service carbon emissions. The carbon impact of option 6 (electric vehicles) results in an approximate 75% reduction in collection emissions.

7.1.3 It is clear that options 2 and 3 have the greatest impact on recycling rate. Option 1 and option 5 result in a reduction of waste against the baseline as the measures implemented under these options target specific materials for reduction.

7.1.4 A strategic cost assessment of options 3, 7 and 8 indicated that in all instances, option 3 (separate food waste) comes out as the most expensive option. This is largely due to the greater cost associated with running a food waste service such as the cost to run several extra vehicles. Implementing an AWC (option 7) is the least expensive option in comparison to the baseline.

7.1.5 Wood has devised a range of carbon management actions which will allow the Authority/Councils to work towards the goal of carbon reduction with guidance as to the input that will be required to implement the initiatives. They are short/medium term actions. The options investigated within the project involve alterations to service contracts or significant capital expenditure which would need to be considered within a detailed Cost Benefit Analysis (CBA) with reference to the Councils budget provisions, procurement schedules and strategic aims. Upon completion of these actions a schedule for the implementation of schemes could be developed against which SMART targets can be allocated.

Appendix A

Historical Trends

Historical trends across the Authority area

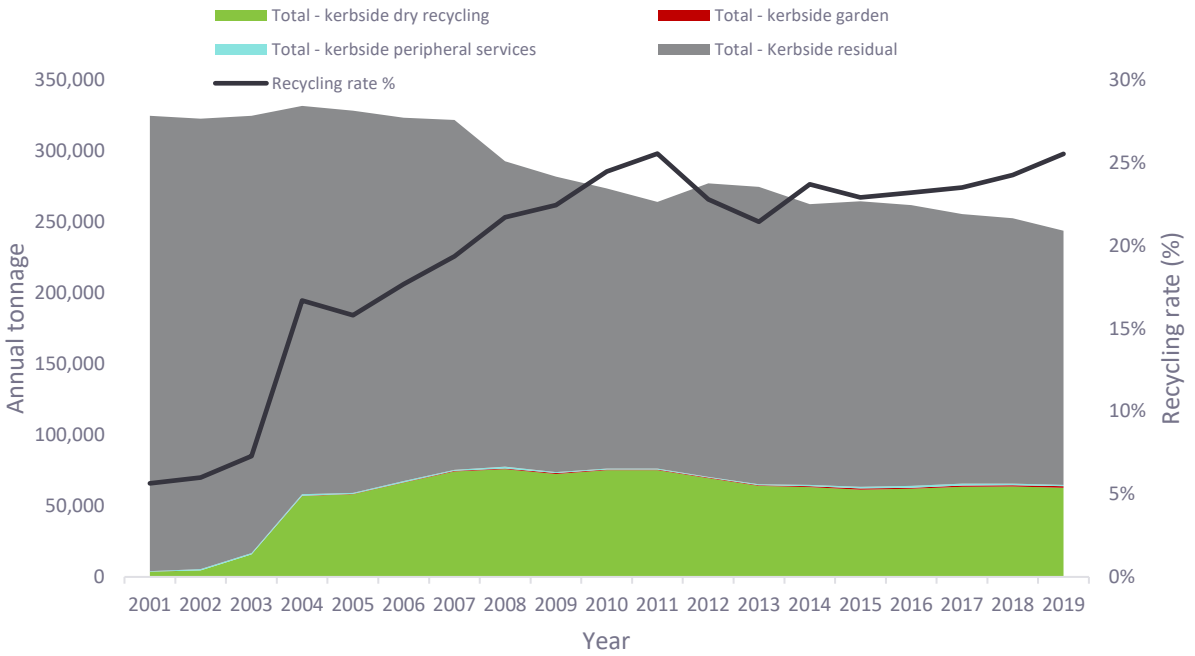
Recycling rate and collected waste tonnages

The overall recycling rate for household collected waste across the Authority increased from 5.6% to 25.5% between 2001 and 2019. The most significant rise was seen between 2002 and 2004, with rates increasing by 11.0% in two years. This trend is seen across each constituent Council historical data.

From 2004, recycling rates increased linearly, plateauing at 25.5% in 2011. During this period, kerbside dry recycling tonnages rose by 32% and kerbside residual waste fell by a similar amount.

Recycling rates fell over the following two years to 21.4% in 2013 due to a change in the sampling process. The Authority changed MRFs, from a 3rd party MRF to the MRF at Smugglers Way. The sampling process for the identification of contamination became more stringent and detailed, resulting in increased contamination percentages to improve the quality of the recycling material processed. Since 2013, recycling rates steadily increased to 25.5% in 2019, primarily due to a steady decrease in residual waste arisings as kerbside recycling remained largely stable.

Figure A.1 Authority tonnage of waste collected via kerbside residual, kerbside dry recycling, kerbside garden and peripheral services (including bulk collections). (Recycling rate is plotted on the secondary axis.)



Recycling material tonnages

After a rapid increase in kerbside recycling tonnage in the 2000s, recycling tonnages from all sources (i.e. kerbside and HWRCs/CAs) had plateaued by 2010. The tonnages of most recyclable materials increased since 2004, with the exception of paper which fell by 42% which may be due to the ongoing transition away from paper to digital media. Paper, glass and card remained the most collected materials, by tonnage, over the 19-year period with glass overtaking paper in 2018. Light-weighting of material over the last decade will also have affected tonnages reported. The recycling tonnages presented below include contamination and therefore represent the lump recycling tonnages as collected at the source.

Figure A.2 Authority annual tonnage of collected dry recycling disaggregated by its composition

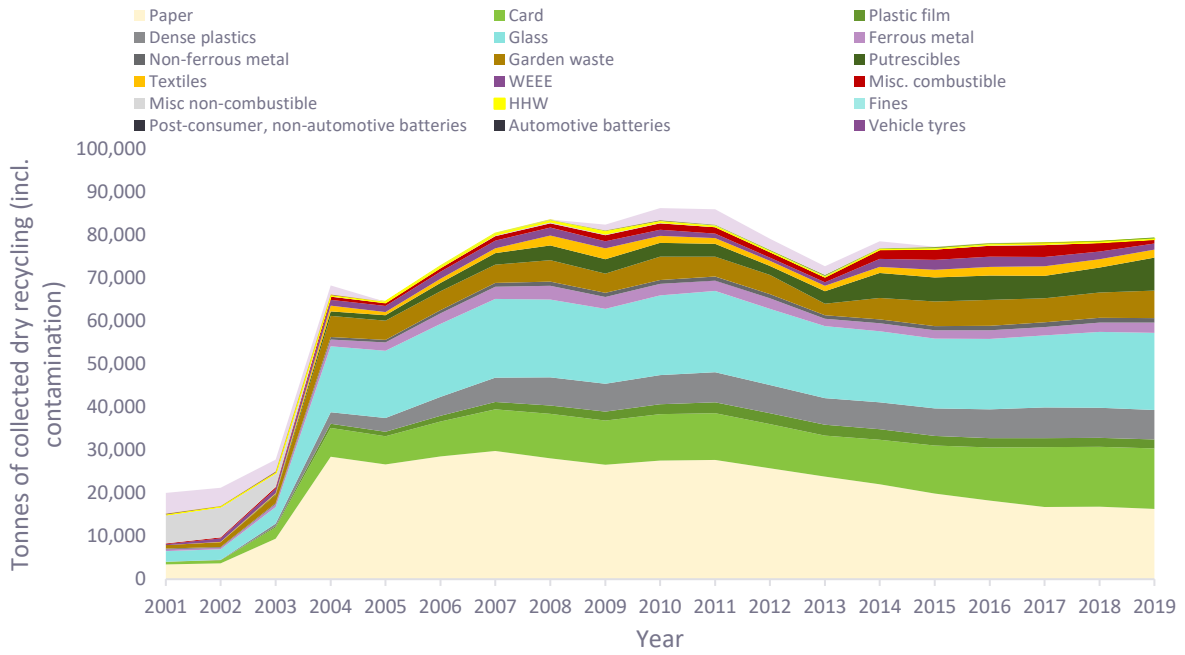
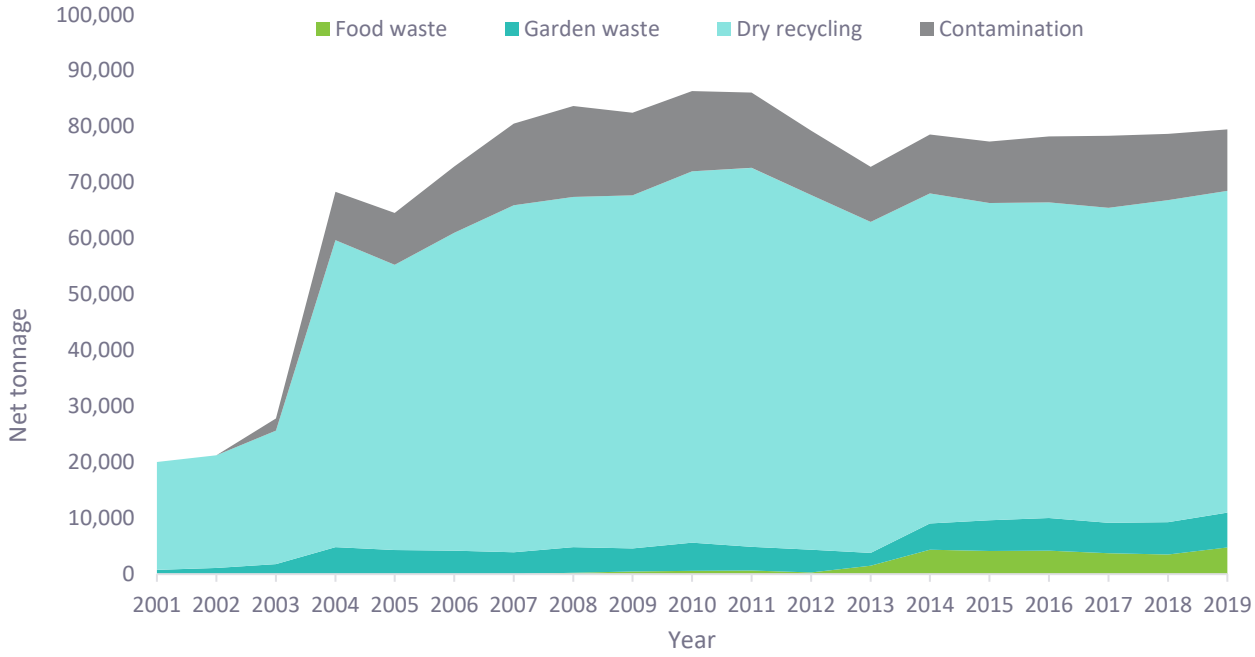


Figure A.3 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure A.3 High level disaggregation of Authority household recycling into food waste, garden waste, dry recyclable material and contamination

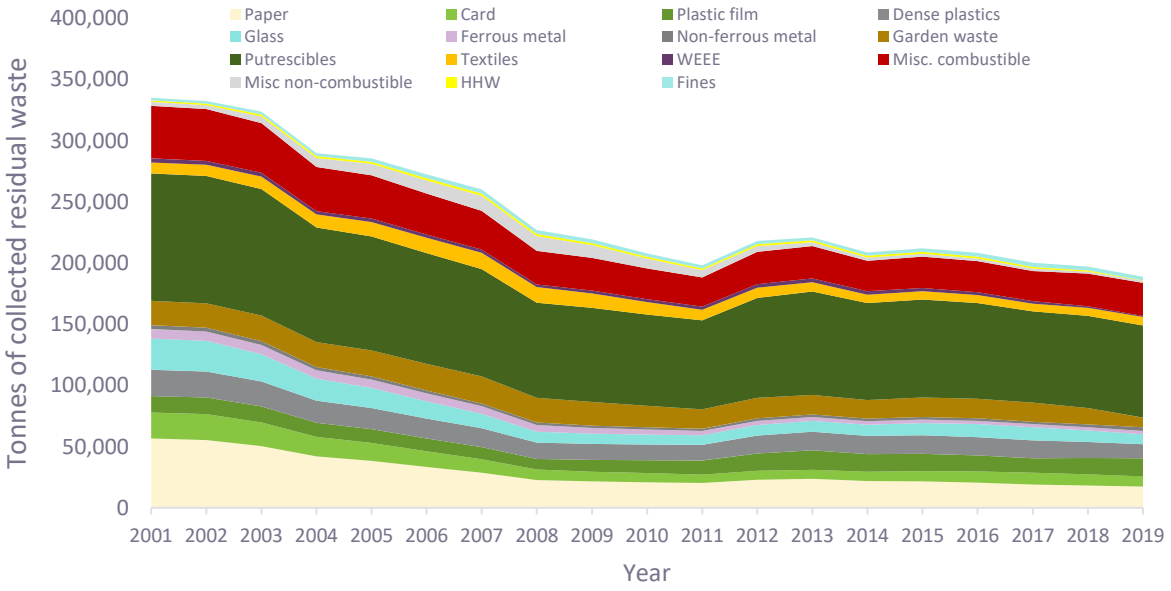


Residual material tonnages

Residual waste tonnages from all sources steadily fell by 44% between 2001 and 2019. Most of this decrease was between 2001 and 2011 where residual waste tonnages decreased by 41%. From 2011 to 2019, residual waste gradually reduced by a further 2%.

The composition of the total residual collected waste stream remained, with a few exceptions, relatively stable despite growth across most streams within the dry recycling stream. Glass and card saw significant reductions as more of these material streams were recycled whereas a reduction in paper was likely due to lower consumption. Garden waste saw a significant decrease in recent years despite only a modest increase within the recycling stream. This may be partly due to more households composting their garden waste at home and to potential changes in the weather/ climate.

Figure A.4 Authority annual tonnage of collected residual waste disaggregated by its composition



Hammersmith & Fulham

Recycling rate and collected waste tonnages

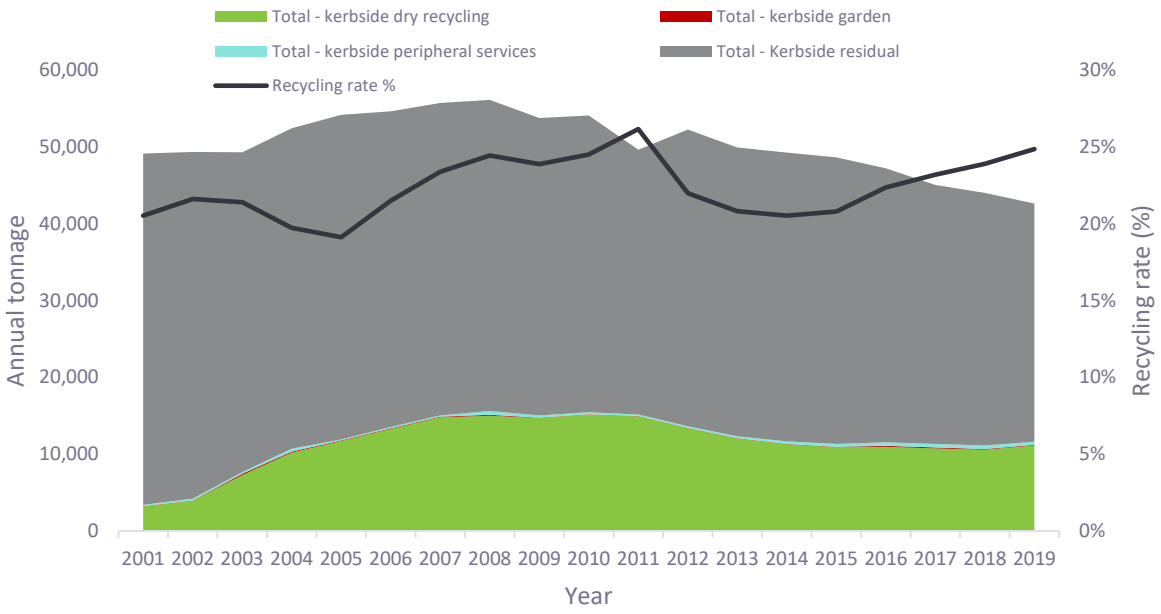
7.1.6 Since 2001, the overall recycling rate for household collected waste increased from 20.5% to 24.9% in 2019. From 2005, the recycling rate increased and plateaued at 24.4% in 2008. Similarly, collected kerbside dry recycling peaked in 2008 at around 15,000 tonnes per annum, whilst kerbside residual waste arisings fell steadily, taking the total household collected waste to a peak of c. 59,500 tonnes in 2008.

7.1.7 The Council's recycling rate increased from 23.9% in 2009 to a peak of 26.2% in 2011, the highest rate to date, after which the recycling rate declined to 22.0% in 2012. This peak in 2011 coincided with a marked drop in collected residual tonnage whilst kerbside dry recycling remained relatively constant. The fall in recycling rate in 2012 coincided with an increase in collected residual waste and a slight decrease in dry recycling.

7.1.8 Between 2012 and 2015, the Council's recycling rate remained consistently below 21.0%, mirroring the total kerbside dry recycling collection which remained stable between 10,700 and 11,300 tonnes. From 2015, the quantity of kerbside dry recycling increased and, as a result, the recycling rate steadily increased almost linearly from 20.8% to 24.9% in 2019. Meanwhile, the total kerbside collection steadily fell by nearly 20% from 38,600 tonnes in 2012 to 31,000 in 2011 which would

suggest that, in recent years, the increase in recycling rate was due to reduced waste generation rather than increased recycling.

Figure A.5 H&F tonnage of waste collected via kerbside residual, kerbside dry recycling, kerbside garden and peripheral services (including bulk collections). (Recycling rate is plotted on the secondary axis)



Recycling material tonnages

Up until 2004, waste data was not recorded with the same granularity as it has been since. In 2004 it is seen that paper made up 50.6% of the dry recycling stream followed by glass (19.6%) and card, (11.2%). Paper, card and glass remained the top three ranking materials in that order until glass tonnage exceeded paper in 2019.

As noted above, the total collected recycling increased between 2004 and 2008 with most material tonnages increasing year on year. Exceptions include garden waste, which experienced a drop in 2007 followed by a large peak in 2008, and paper, which reached a maximum of 6,950 tonnes in 2007 before steadily falling year on year. As a result of collected paper tonnages decreasing, all other material streams experienced a gain in the proportion of the dry recycling stream with the exception of glass, which fell from 18.9% to 17.7%. Textiles have experienced the greatest growth in this 2004-2008 period, increasing its percentage share tenfold. As in the case of the recycling tonnages presented for the whole Authority area, the recycling tonnages presented below are inclusive of some levels of contamination.

Figure A.6 H&F annual tonnage of collected dry recycling disaggregated by its composition

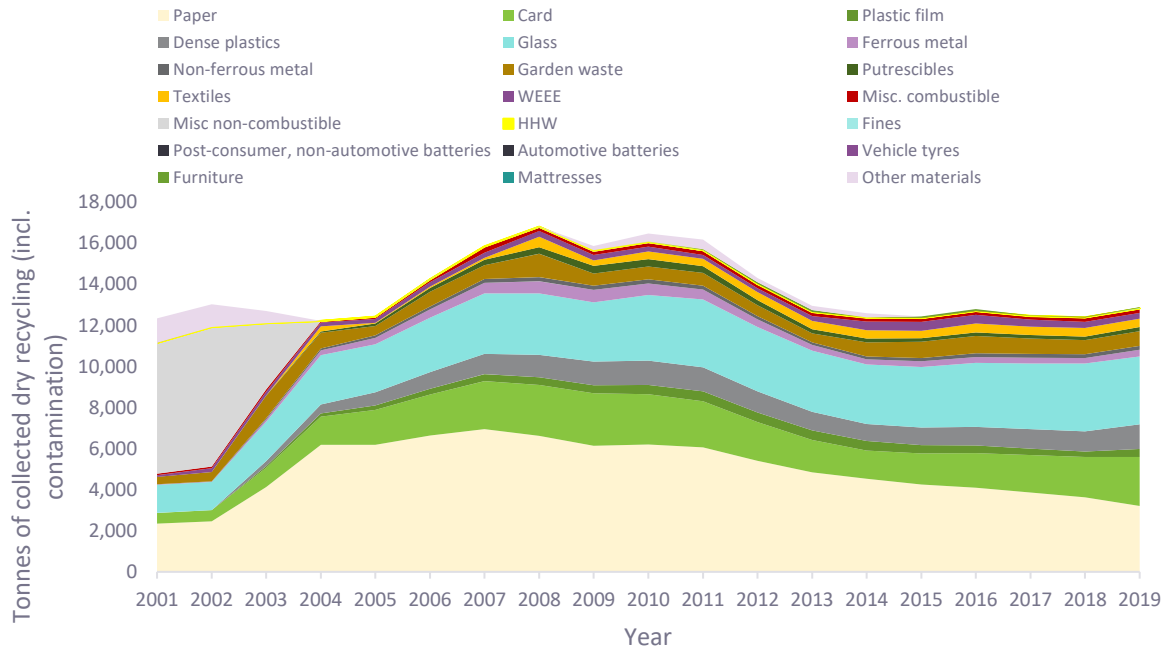
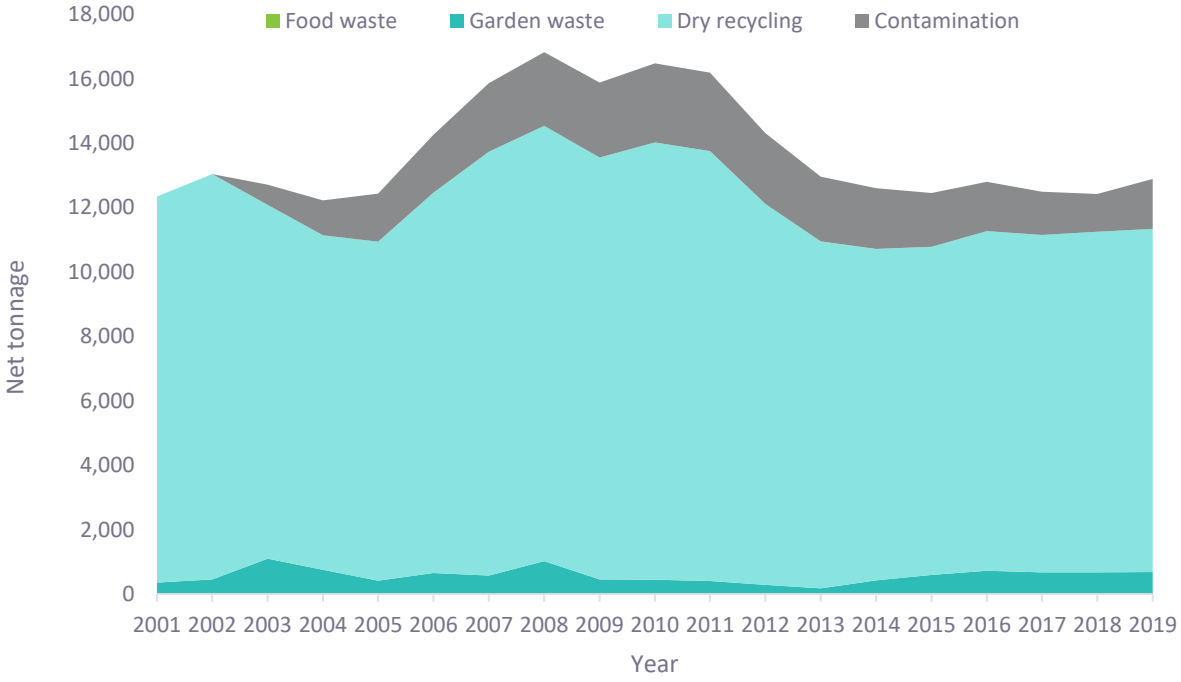


Figure A.7 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure A.7 High level disaggregation of H&F household recycling into food waste, garden waste, dry recyclable material and contamination

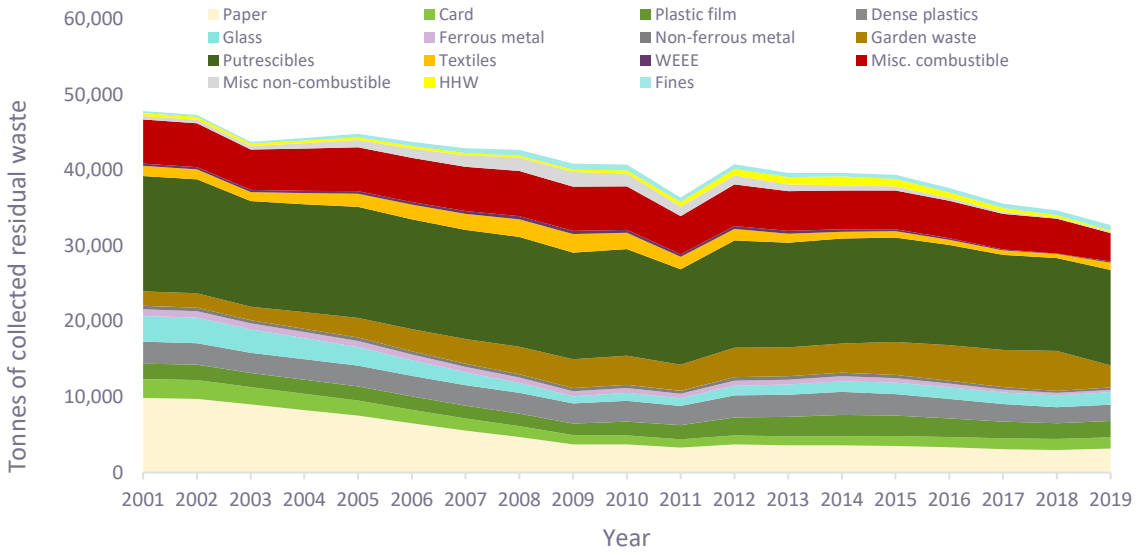


Residual material tonnages

Residual waste tonnages steadily fell by over 30% between 2001 and 2019. Most materials maintained a similar proportion within the waste stream. The exceptions, garden waste and plastic film, increased by 66.7% and 14.3% respectively during this period, despite garden waste tonnages falling since 2018.

Paper saw the greatest reduction, as discussed previously, followed by glass and miscellaneous combustibles; falling by 65%, 48% and 30% respectively. Miscellaneous combustibles, HHW and ferrous metals also saw significant reductions of over 50%, however it is noted that these are minor streams and large annual variations in certain categories (e.g. miscellaneous combustibles) may be partly due to inconsistencies in recording/ reporting of these waste streams.

Figure A.8 H&F annual tonnage of collected residual waste disaggregated by its composition



Royal Borough of Kensington & Chelsea

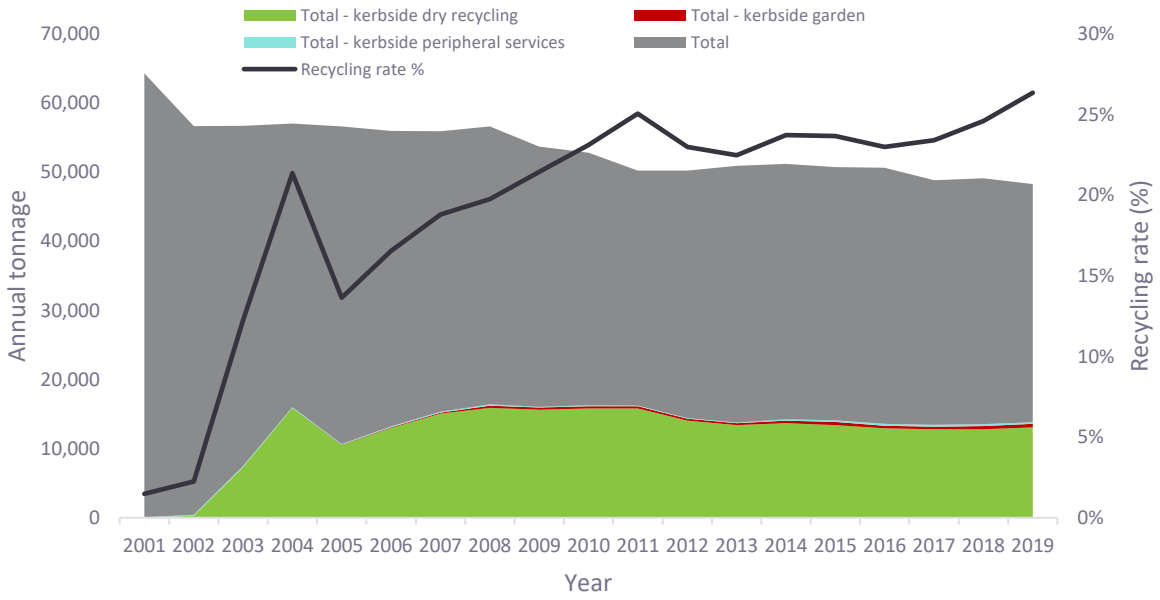
Recycling rate and collected waste tonnages

Since 2001, the overall recycling rate for household collected waste has increased significantly from 1.5% to 26.4% in 2019. The recycling rate increased fourteen-fold between 2001 and 2004 to 21.4%. This was followed by a sharp fall in 2005 to 13.6%. This trend was mirrored by the quantity of collected kerbside dry recycling during this period, which reached a peak of c.16,000 tonnes in 2004 before dropping in 2005.

From 2005, the quantity of collected kerbside dry recycling increased, plateauing at around 16,500 tonnes between 2008 and 2011. During this period, the recycling rate increased steadily to a peak of 25.1% in 2011, mainly due to a steady fall in collected residual waste by 17% over the period.

Despite a slight fall in 2012 and 2013 of less than 3%, the quantity of collected kerbside dry recycling remained relatively stable, returning to 2011 levels by 2019. Meanwhile the quantity of kerbside residual waste remained stable. Despite the relatively small fluctuations in collected kerbside residual and dry recycling, the recycling rate was more significantly affected, falling from a peak of 25.1% in 2011 to 22.5% in 2013. Since then, the recycling rate has increased steadily to 26.4% in 2019.

Figure A.9 RBKC tonnage of waste collected via kerbside residual, kerbside dry recycling, kerbside garden and peripheral services (including bulk collections). (Recycling rate is plotted on the secondary axis)



Recycling material tonnages

In 2004, 7,720 tonnes of paper were collected, making up 46.1% of the waste stream followed by card (18.4%) and glass (12.7%). Paper, card and glass remained the top three ranking materials throughout the entire period.

Paper tonnages fell by over 50% between 2004 and 2019, likely due to the transition to digital media. Glass almost doubled in the same period whilst card remained relatively stable. Glass overtook card as the second most collected material in 2007 and overtook paper in 2016 to become the most collected material.

Collected garden waste has increased steadily, and nearly seven-fold since 2004. Putrescibles made up a significant proportion of the composition between 2005 and 2011 before falling between 2011 and 2017. Before 2018, when the Council introduced separate kerbside food waste collections, food waste tonnages reported in the recycling were contamination. Therefore, before 2011, food waste was a considerable source of contamination in the recycling, which was steadily tackled after 2011. In recent years the proportion of food waste in the composition of total recycling collected has increased, but this is because a separate kerbside food waste collection was introduced by the Council in two round areas, and not because of increased food waste contamination of the dry recycling streams.

Figure A.10 RBKC annual tonnage of collected dry recycling disaggregated by its composition

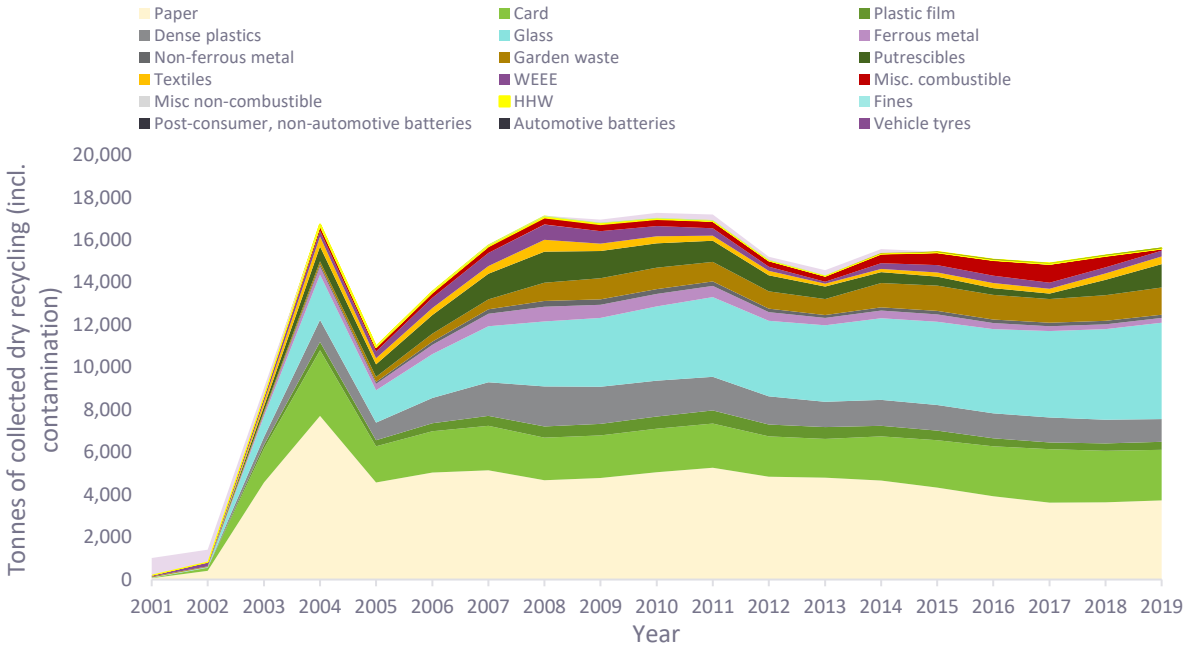
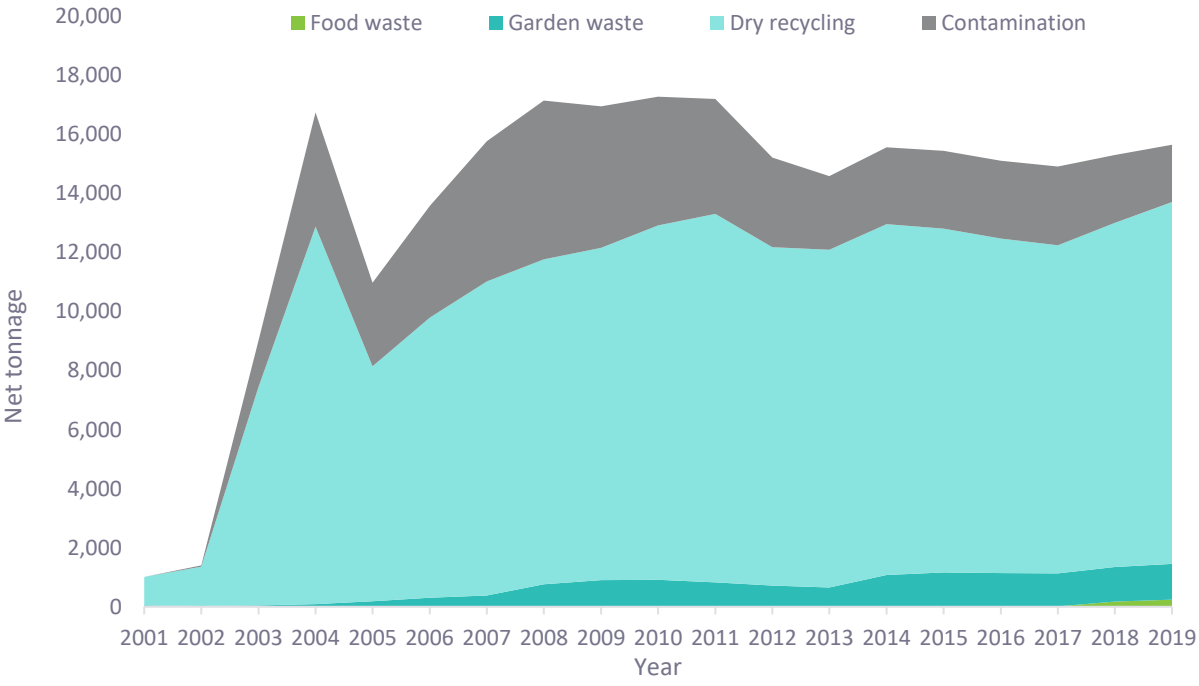


Figure A.11 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure A.11 High level disaggregation of RBKC household recycling into food waste, garden waste, dry recyclable material and contamination

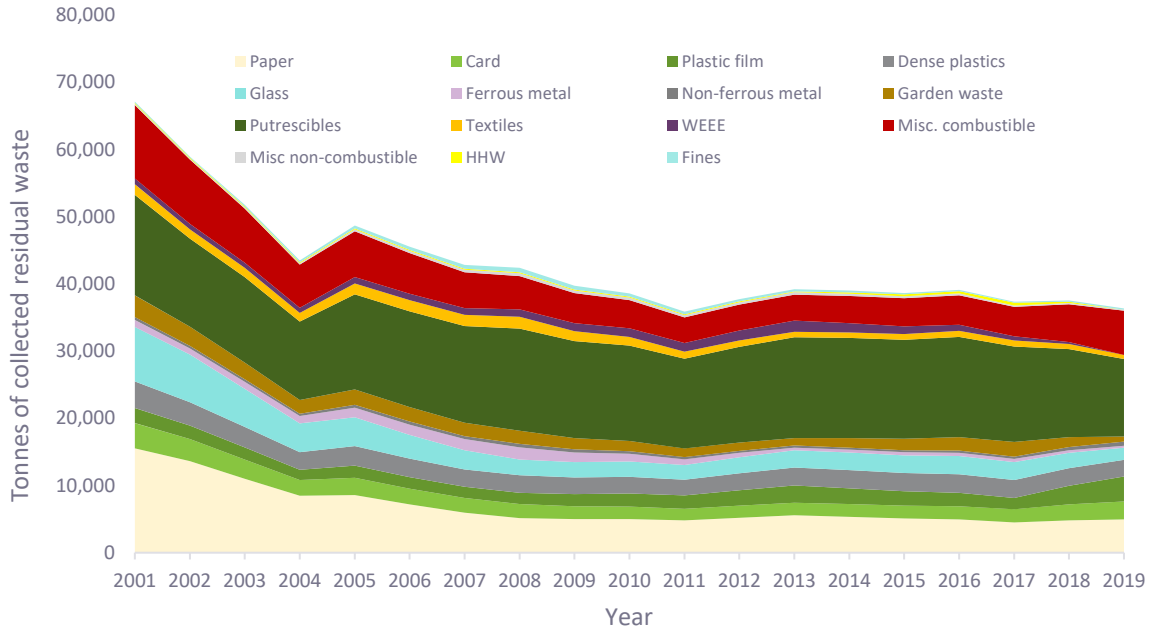


Residual material tonnages

Residual waste collection tonnage steadily fell by almost half between 2001 and 2019. The most significant fall being between 2001 and 2004, followed by an increase in 2005 which aligned with the drop in recycling

rate as discussed above. All material streams have maintained a similar proportion, with most materials reducing in tonnage year on year. Most notable are paper, as discussed previously, and putrescibles which have made up a smaller proportion in recent years. Conversely, miscellaneous combustibles and plastic film have both increased in recent years.

Figure A.12 RBKC annual tonnage of collected residual waste disaggregated by its composition

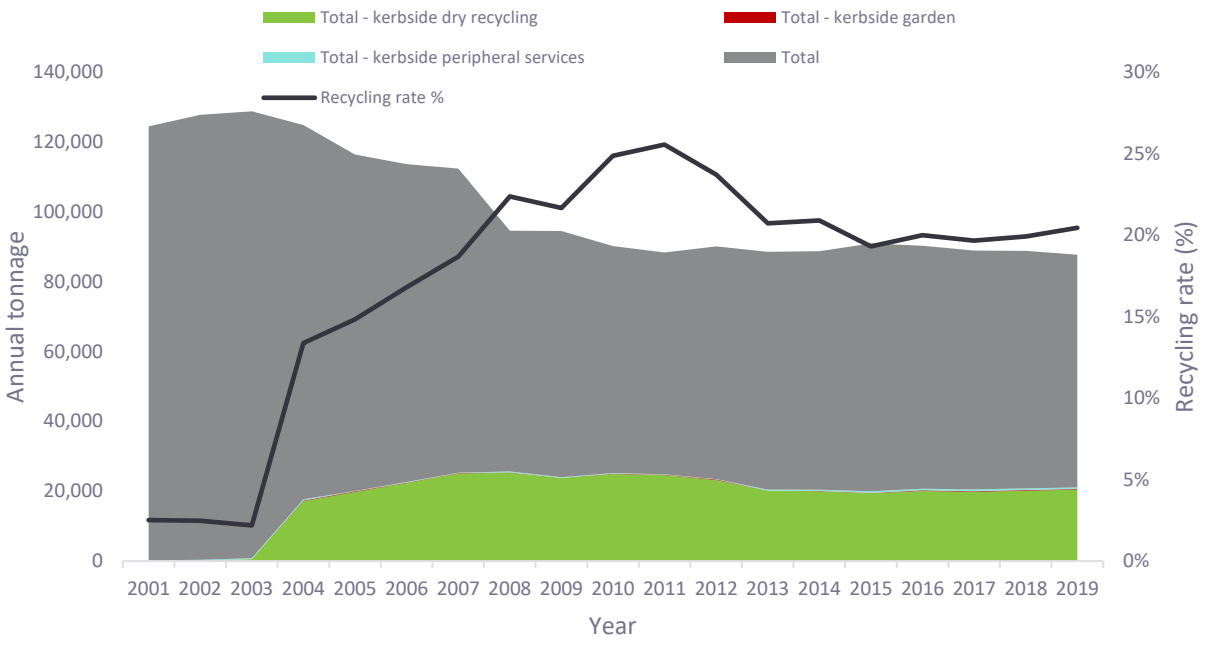


Wandsworth

Recycling rate and collected waste tonnages

The overall recycling rate for household collected waste increased from 2.2% to 20.4% between 2001 and 2019, with a marked increase from 2.2% in 2003 to 13.4% in 2004. A steady increase in recycling rate was maintained until 2008, corresponding to a steady decrease in kerbside residual waste tonnages and an increase in kerbside dry recycling tonnages during this period. The quantity of collected kerbside dry recycling plateaued from 2008 whilst residual waste also remained stable. This resulted in the recycling rate peaking at 25.6% in 2011 and decreasing to 19.3% in 2015. Since 2015, the recycling rate gradually increased to 20.4% in 2019.

Figure A.13 Wandsworth tonnage of waste collected via kerbside residual, kerbside dry recycling, kerbside garden and peripheral services (including bulk collections). (Recycling rate is plotted on the secondary axis)



Recycling material tonnages

By 2004, paper collection reached 8,730 tonnes, making up 43.1% of the dry recycling stream followed by glass (25.3%) and card (7.7%). Paper, glass and card remained the top three ranking materials until 2019.

Paper tonnages continued to increase gradually to 10,500 tonnes in 2007 before falling by 52% between 2004 and 2019, likely due to the transition to digital media. Glass tonnages decreased by 20% in comparison and overtook paper in 2017 to become the most collected material. Card increased by over 40% and remained the third most collected material throughout.

Dense plastics tonnages experienced steady growth over the same period, increasing by over 70%. Garden waste, textiles and miscellaneous non-combustibles also more than doubled in the same period.

Garden waste tonnages have steadily increased by seven-fold since 2004. Putrescibles made up a significant proportion of the composition between 2005 and 2011 before falling between 2011 and 2017. In recent years it increased, replacing the share held by miscellaneous combustibles. 'Other materials' experienced a rise and fall between 2008 and 2015, which may be as a result of material reclassification.

Figure A.14 Wandsworth annual tonnage of collected dry recycling disaggregated by its composition

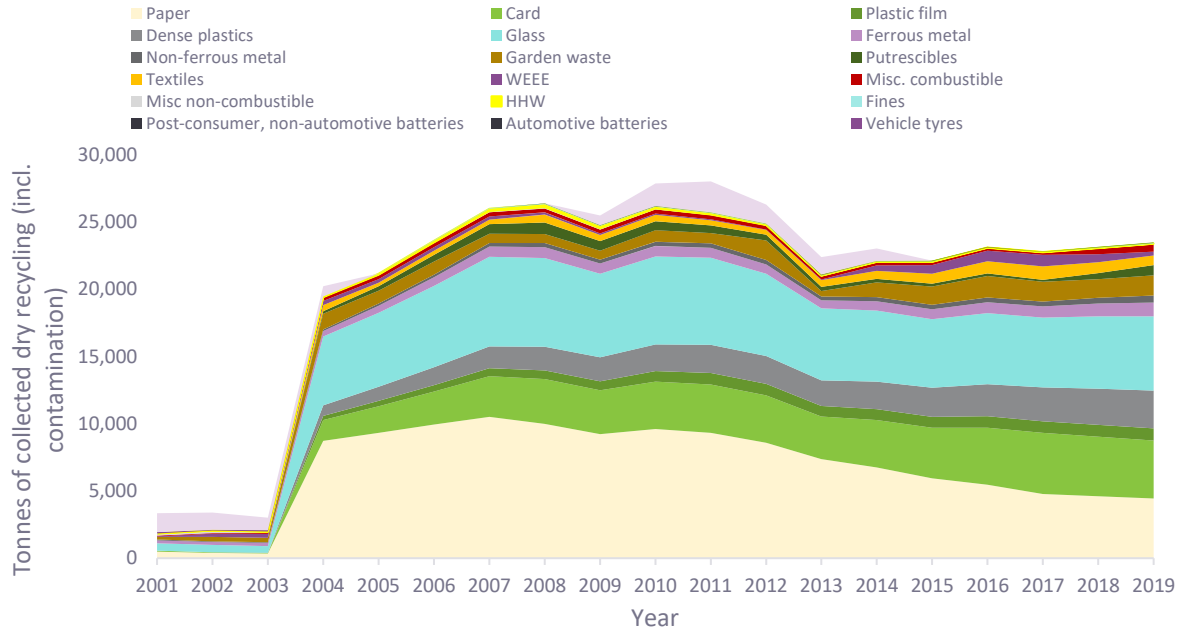
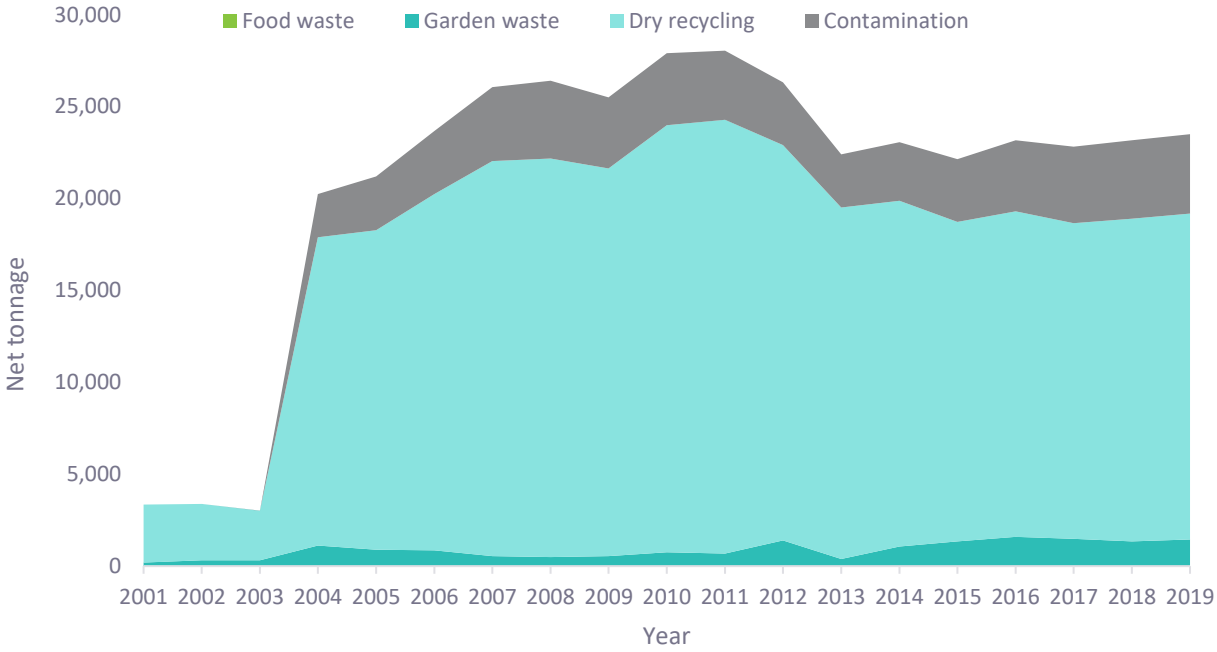


Figure A.15 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure A.15 High level disaggregation of Wandsworth household recycling into food waste, garden waste, dry recyclable material and contamination

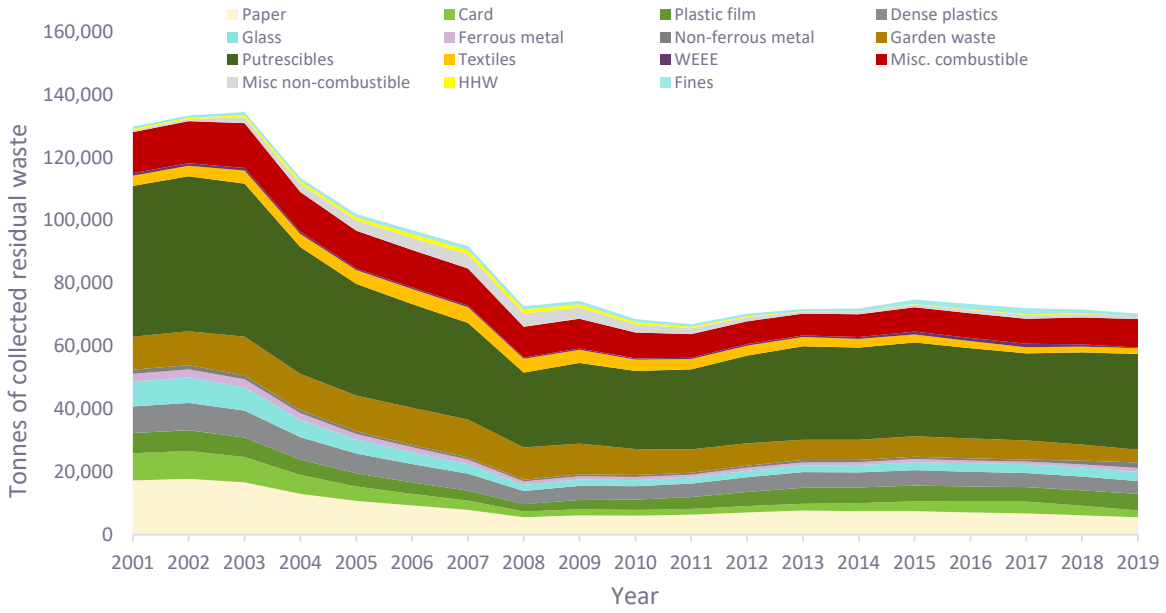


Residual material tonnages

Residual waste collection tonnages steadily fell by almost half between 2001 and 2019. Most of this decrease was between 2003 and 2008 where residual waste collection tonnage reduced by 36%. Since 2008, total residual tonnages remained relatively stable.

Paper, card, glass and dense plastics in the residual waste stream saw the greatest decline between 2003 and 2004. Putrescibles also saw a marked decrease of nearly 20% though it does not appear that it was transferred to the recycling tonnages during this period. From 2004 onwards, most materials maintained a similar proportion within the waste stream with most materials falling between 40 and 70% between 2003 and 2019.

Figure A.16 Wandsworth annual tonnage of collected residual waste disaggregated by its composition



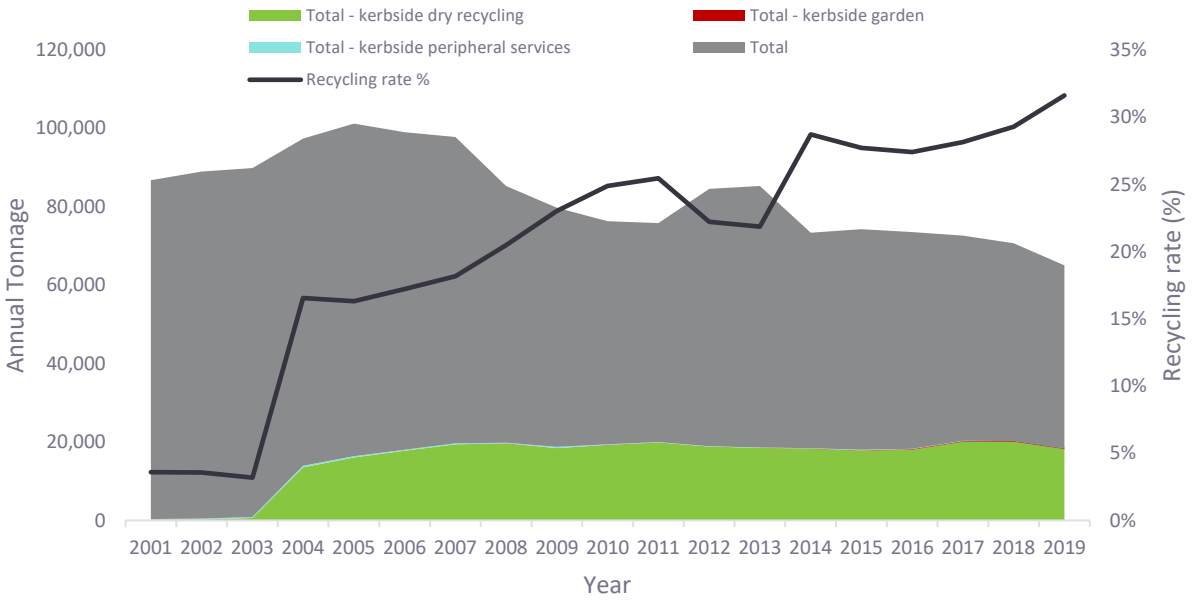
Lambeth

Recycling rate and collected waste tonnages

The overall recycling rate for household collected waste increased from 3.6% to 31.6% between 2001 and 2019. The most significant increase is seen from 2.2% in 2003 to 13.4% in 2004. A steady increase in recycling rate was maintained until 2011, corresponding to a steady decrease in kerbside residual waste collected and a marginal increase in kerbside dry recycling during this period. The quantity of collected kerbside dry recycling plateaued from 2007 whilst residual waste continued to fall. Subsequently, the recycling rate plateaued at 25.5% in 2011 before decreasing to 21.9% in 2013. This was largely influenced by an increase in residual tonnage whilst the quantity of collected kerbside dry recycling remained stable.

Since 2013, the recycling rate grew to 31.6% by 2019, driven by a decrease in residual waste whilst recycling tonnages remained stable, with a slight decrease from 2018.

Figure A.17 Lambeth tonnage of waste collected via kerbside residual, kerbside dry recycling, kerbside garden and peripheral services (including bulk collections). (Recycling rate is plotted on the secondary axis)



Recycling material tonnages

By 2004, paper collection reached 5,850 tonnes, making up 30.6% followed by glass (30.0%) and garden waste (14.9%). Paper tonnages increased slightly to 7,200 tonnes in 2007 before falling by 14% between 2004 and 2019, likely due to the transition to digital media. Glass tonnages decreased by 20% in the same period whereas garden waste has remained largely the same despite experiencing a dip between 2012 and 2014.

Card steadily grew nearly six-fold in the same period, becoming the third most collected material in 2019. Dense plastics also increased more than five-fold until 2017 but decreased from 2018. Putrescibles made the strongest gains, increasing by more than 40 times the quantity collected in 2004 to become the most collected recyclable material in 2019. This was driven by the separate kerbside food waste collections that the Council introduced in 2013/2014, Food waste tonnages shown in the recycling tonnages collected could be considered contamination included in the dry recycling stream.

Figure A.18 Lambeth annual tonnage of collected dry recycling disaggregated by its composition

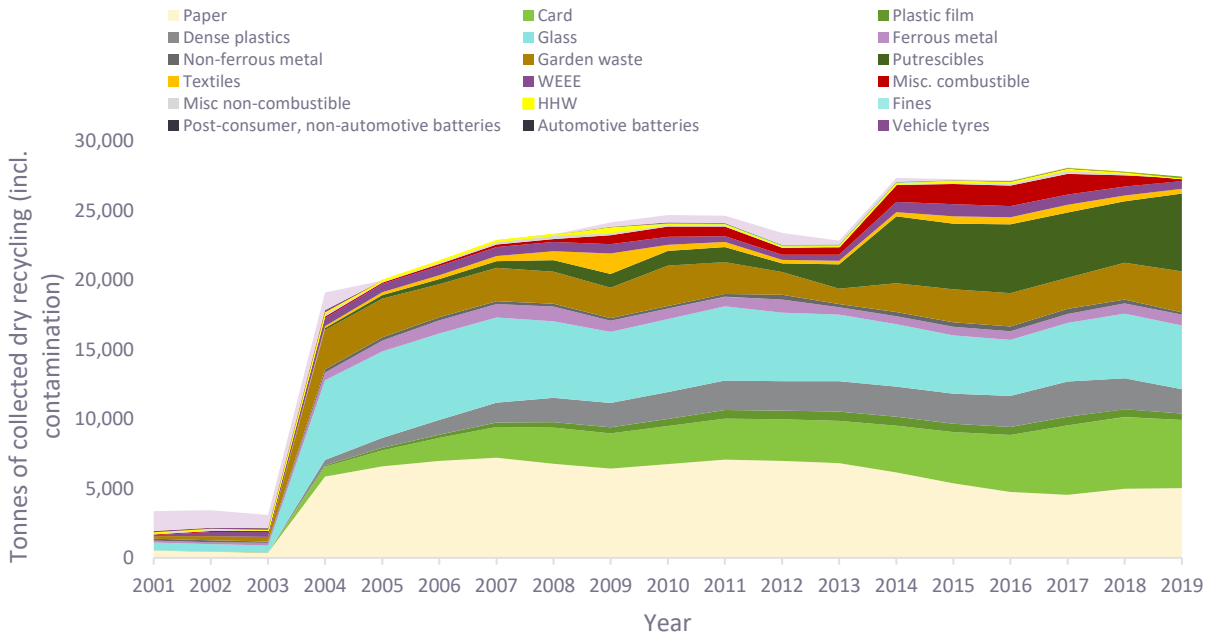
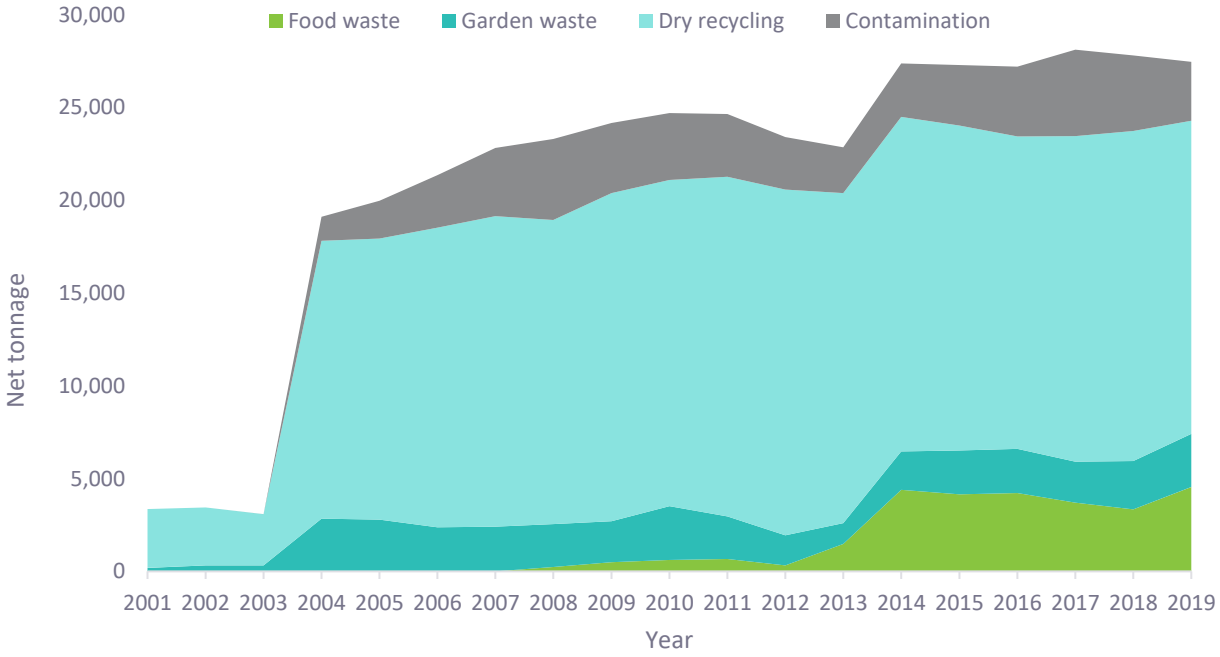


Figure A.19 disaggregates the net household recycling into four major categories; food waste, garden waste, dry recyclable material and contamination – material that cannot be recycled. This illustrates the level of contamination collected within the dry recycling stream. Dry recycling includes all recyclable materials including textiles and WEEE but excludes food and garden waste.

Figure A.19 High level disaggregation of Lambeth household recycling into food waste, garden waste, dry recyclable material and contamination

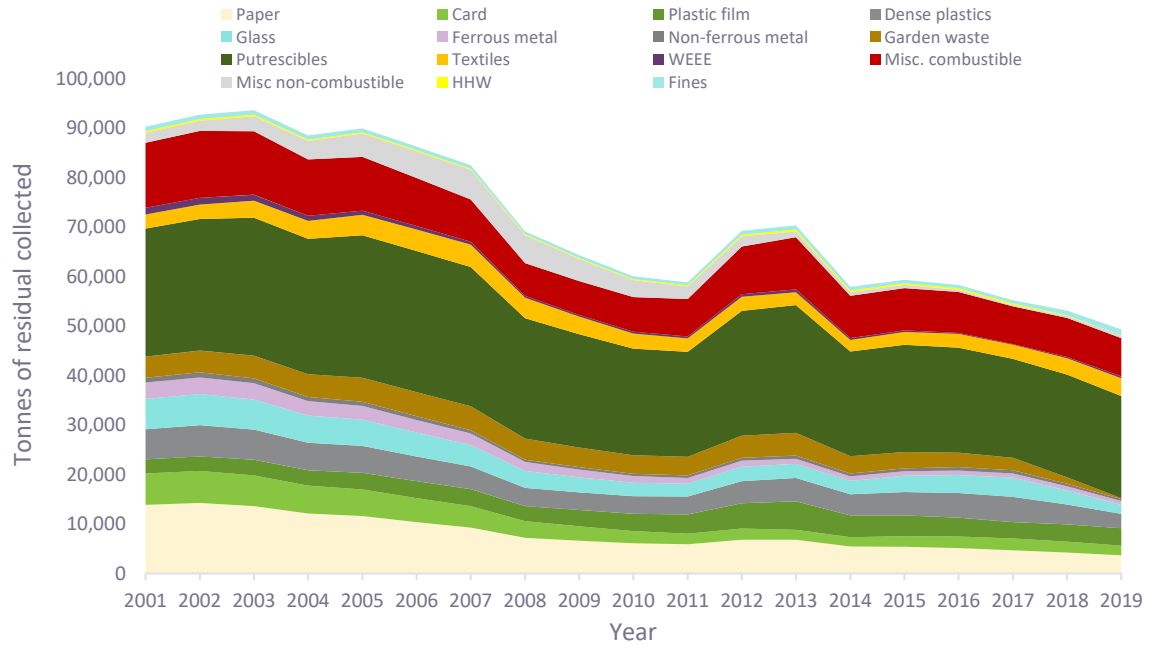


Residual material tonnages

Residual waste collection tonnages reduced steadily by almost half between 2001 and 2019. Most of this decrease was between 2003 and 2011 where residual waste collection tonnage decreased by 37%.

Throughout 2001 to 2019, the composition of the total residual collected waste stream remained relatively stable despite significant variation within the dry recycling stream. Most material tonnages decreased by varying levels of between 25% and 95%, except for plastic film and textiles which grew by 12% and 5% respectively. Garden waste in the residual waste stream has decreased significantly in recent years, almost halving since 2017.

Figure A.20 Lambeth annual tonnage of collected residual waste disaggregated by its composition



Appendix B

Baseline Modelling

A baseline model has been developed to support the assessment of KPIs on the three core areas of:

- Waste Flows;
- Service Costs; and
- Carbon Impact.

Wood and the Authority verified and validated the model against the historic position to ensure that the model accurately represents the services of the Authority and its constituent Councils. The model has been developed to provide data at constituent Council level, as well as providing a consolidated Authority wide view.

It was agreed with the Authority that all municipal waste collection services were to be included in the waste flow modelling apart from street cleansing and markets waste. The assessment has primarily focused on the waste treatment/disposal delivery of the service, although high level estimates of kerbside resources and costs required to deliver the baseline (and thereafter the options) have also been calculated.

Waste Flow Modelling

Using the data provided by the Authority (and pre-agreed, evidence-based assumptions) a detailed baseline model has been developed (in Microsoft Excel), which includes historical (from 2002 onwards), current and future compositional data and waste flows for recycling, residual waste and total waste collected, detailed by material type. The duration of the waste flow model is up to 2035. Capture and contamination rates for materials targeted for dry recycling have also been estimated over this time period. The model includes information on the number of households and quantities of waste generated per household.

Future waste growth has been incorporated into the models based on housing growth rates[4], and the composition, contamination, yield and capture rate data from the last full financial year.

The waste treatment/ disposal routes and quantities and types of waste managed via each route have also been identified. This will allow the estimation of historical and current carbon emissions for the Authority.

Cost Modelling

The output of the waste flow modelling, along with a range of operational and cost assumptions relating to the kerbside collection services operated by the constituent Councils, has been used to populate a bespoke cost model (in Microsoft Excel). The cost model utilises key service information to produce a strategic cost assessment of options 3, 7 and 8.

More specifically, baseline modelling requires calibrating known inputs (such as tonnages collected and households served) to known outputs (such as the number of vehicles and crew required to deliver the services). It is essential that the resources and logistics of the existing kerbside services are accurately reflected within the baseline so that it serves as a reliable foundation for testing alternative options. In summary, the baseline reflects:

- The composition of the kerbside waste and tonnages collected by different services;
- Current levels of participation, set out, recognition, capture;
- The characteristics of the Authority (for example, the number of households and rurality);

[4] GLA 2018-based housing-led population projections

- Travel logistics; and
- Current staff, vehicle and container numbers, types and costs.

This will allow a credible basis to be formed from which to establish the change in resource requirements and costs for different potential future service configurations, ensuring that the specific constraints of the Authority are properly reflected. It is important to note that the output from the cost model is not in the form of a full budgeting cost model, and is an indicative estimate on which the impact of options can be gauged. Furthermore, the model is not a detailed routing tool or a comprehensive financial model but includes all costs that are relevant to the day-to-day operations of the key waste management activities, as identified below. Information from each Council on the key costs of the service that fall within the scope of the options identified have been incorporated into the model and used to determine their baseline costs. The costs include the following variables:

- Number of vehicles & staff
- Annual cost rate for vehicles
- Annual frontline staff costs (collection crew and supervisors)
- Annual overheads
- Container replacement costs
- New container costs (if applicable)
- Facility gate fees and material prices (if applicable)

Baseline model assumptions

In order to evaluate kerbside waste and recycling collection options it was first necessary to gather underpinning information and data describing the nature of the Authority area, its population, tonnages collected and existing waste service performance. Data was primarily taken from WasteDataFlow (WDF) and supplemented by Authority provided data. It was from this base data that modelling parameters were developed (e.g. recycling yields) and approaches to filling gaps in existing knowledge, using informed assumptions, were agreed. Local and/or Authority-specific data was always used in preference to alternative data sources and/or default values to ensure the baseline model is as representative as possible.

Detail on the assumptions and other information used as inputs to the baseline and options modelling exercise will be provided as an appendix when these assumptions have been finalised. A description of the assumption sources and data that comprise them is included below.

Waste yield assumptions

Waste tonnages by source and material type were obtained from WDF data provided by the Authority. WDF provides a breakdown of recyclable materials collected by source, split by kerbside and HWRC/ CA site, and by household and commercial sources. When materials are collected comingled (as is the case for the constituent Councils), however, WDF does not provide a detailed breakdown of the materials that comprise the comingled stream. Waste collected at HWRCs tend to be more detailed, because the majority of recyclables collected at HWRCs are separated at source.

To obtain a detailed breakdown of the comingled materials collected at the kerbside, composition studies carried out by the Authority in regular intervals were used. By combining the information included in the composition studies with the tonnages of comingled recycling collected, it was possible to obtain detailed breakdowns of the tonnages of the different materials comprising the comingled recycling stream. Where the composition of comingled recycling in a year was not available, a proxy composition was obtained by interpolating the values between available data intervals.

A similar approach was undertaken to estimate the composition of residual waste, in order to understand the breakdown of the type of materials and their tonnages in the total waste arisings and ensure that the capture rate of materials in the options modelling is held at realistic levels.

Waste yields were simply calculated by dividing the material tonnages collected in a constituent Council by the total number of households in the Council.

Operational assumptions

Operational assumptions relating to the kerbside services were provided by the constituent Councils in proformas issues by Wood. Details obtained include:

- Collection service arrangements operated by each constituent Council, such as the number of kerbside services operated and the household numbers and types on each service
- Types and numbers of resources required to deliver each service (collection crew, vehicles and containers)
- Logistical details associated with each service (travel logistics)
- Other useful operational details, such as the service participation and container set-out rates

Cost assumptions

Cost assumptions associated with the delivery of the kerbside services have been obtained from the constituent Councils. Such information revolves around details of the day-to-day operation of the kerbside services, and it includes staff, vehicle, container and other service delivery costs.

Material processing costs and sales income assumptions have been obtained from the Authority to estimate overall system costs.

Appendix C

Options Identification

In developing the options, a review of policy documents was undertaken including the national Resources and Waste Strategy, The London Mayor's Environment Strategy and the respective local Council policies. This Appendix outlines the relevant policies and the focus and initiatives that have shaped the options agreed upon, noting that not all initiatives have been taken into account at the modelling stage due to uncertainties and lack of evidence and data to substantiate the approach. Some of the policies may become mandatory and/or may impact consumption patterns and products available to consumers, whereas some of the policies are non-statutory, local level aspirations and actions.

Option 1 Waste reduction per capita

Table C.1 Option 1 relevant policies

Policy document	Relevant focus and initiatives	Implementation
Resource & Waste Strategy	Eliminating avoidable waste by 2050; removal of single use plastics; encouragement of re-use and lease schemes for white goods	Not enforced but changes may impact consumer behaviour, product selection and consumption patterns.
Mayor of London's Environment Strategy	Reduce and reuse strategies; focus on cutting single-use packaging and food waste by 20%; Local Authorities encouraged to prepare reduction and recycling plans.	Non-statutory target
Wandsworth Environment & Sustainability Strategy 2019 - 2030	Targets to reduce amount of waste generated from municipal buildings and quantity of household waste per household, reduction in single-use plastics.	Council level target

Under option 1 an overall reduction in waste was modelled based on previous patterns of waste reduction observed in the last few years as well as factoring in initiatives and campaigns introduced to reduce food waste ('Love food, hate waste' campaign, Courtauld commitment) and those aimed at encouraging reuse of products.

Option 2 Increase in recycling rate

Table C.2 Option 2 relevant policies

Policy document	Relevant focus and initiatives	Implementation
Resource & Waste Strategy	Key milestones: municipal waste recycling targets are set at 55% by 2025, 60% by 2030 and 65% by 2035, with a review clause in 2028. Overall packaging waste recycling targets are set at 65% by 2025 and 70% by 2030.	Mandatory target
	Extended Producer Responsibility (EPR) will be introduced in 2023, subject to consultation. It is not clear how this will be rolled out but if a separate collection of packaging was enforced then the Councils recycling rate would increase.	Potential to be enforced
	Incentives to allow consumers to purchase sustainably with consistent labelling on packaging and consistent materials for recycling.	Not enforced but changes may impact consumer behaviour, product selection and consumption patterns.
		Potential to be enforced

Policy document	Relevant focus and initiatives	Implementation
	To ensure better waste collection and recycling the government will specify a core set of materials to be collected by all local authorities and waste operators; emphasise greater collection of glass separate from paper (the separate collection of glass will have a potential of increasing costs for the Councils if more glass ends up in the residual stream); review collection models for densely populated commercial and residential districts to improve recycling; improve working arrangements and performance between local authorities, especially in 'two-tier' areas where a waste disposal authority (WDA) is responsible for disposing of waste collected by smaller district authorities (waste collection authorities, WCAs); consider the introduction of a tax on the incineration of waste further to consultation and review, should wider policies not deliver the Government's waste ambitions in the long-term.	
Mayor of London's Environment Strategy	Target to recycle 65 per cent of its municipal waste by 2030, and waste authorities should aim to achieve 45% household waste recycling rate by 2025 and 50% household waste recycling rate by 2030. Promotes recycling, particularly of high carbon and high value materials, such as plastic, metals and textiles. Local Authorities encouraged to prepare reduction and recycling plans, ensure a minimum level of recycling service, i.e., 6 main materials.	Non-statutory target Regional level aspirations
Wandsworth Environment & Sustainability Strategy 2019 - 2030	Target to increase the % municipal waste recycled 2019 – 2022	Council level target
RBKC Air Quality and Climate Change Action Plan 2016 - 2021	Target to increase the municipal recycling rate by 2% from April 2019 to April 2020.	Council level target

The Mayor's London Environment Strategy has set a target for 50% of local authority collected waste in London to be recycled by 2030, in order to help reach an overall 65% municipal target. A pragmatic approach has been taken into account, in agreement with the Authority, when identifying recycling targets, appreciating that urban areas have considerable barriers that prevent them from significantly improving their recycling rates.

Other initiatives, like those introduced by Resource London in their Flats recycling project, may improve recycling in purpose-built flats. The key message was good quality and well communicated services improve performance (textiles, food and plastic film were issues). The residents had lack of knowledge and access to good quality information – e.g., signs, access to bins. One of the solutions included the production of tenant packs - flats recycling package – which is to be rolled out to all flats in London. Findings showed a 24% decrease in overall contamination rates (from 31% to 23%). These packages may therefore help increase recycling rates in the London Councils.

Under option 2 an increase in the recycling rate was modelled, with a particular focus on plastics, but also considering wider remit as Councils continue to tackle contamination through interventions as mentioned.

Option 3 Separate food waste collection to AD/IVC vs Status Quo

Table C.3 Option 3 relevant policies

Policy document	Relevant focus and initiatives	Implementation
Resource & Waste Strategy	Separate food waste collections by 2023, subject to consultation. References that AD represents best environmental outcome for food waste that cannot be prevented.	Potential to be mandatory
Mayor of London's Environment Strategy	To make sure Councils are providing separate food waste collections, the Mayor will hold copies of contract databases and will be alerted when contracts are due for renewal/ expiry. The recycling of materials (including anaerobic digestion) that are left from homes and businesses, and the value of truly non-recyclable waste should be maximised, by generating low carbon energy.	Potential to be mandatory Regional level aspiration
RBKC Air Quality and Climate Change Action Plan 2016 - 2021	Plan to review and model different waste collection systems and assess whether introducing a Council-wide food waste collection will be environmentally beneficial and identify solutions to improve waste collection rounds.	Council level action

A waste composition analysis was undertaken by the Authority during a food waste trial in the South of the RBKC. Four surveys over a 12-month period were carried out to assess the impact of the food waste collection on the behaviour change that may encourage residents to think more about the food they are throwing away and to focus their attention on the dry recycling to test the theory that it could have a positive impact. The results showed that there was no impact on overall waste tonnages. Reduction in overall waste tonnages will therefore not be factored into the modelling.

Under option 3 a separate collection of food waste was modelled with carbon impacts between AD/IVC and the Status Quo (EfW) to also be assessed. There will be some level of carbon savings where food waste is currently disposed of via the general waste and incinerated, with AD treatment having a greater carbon saving over all other treatment routes. The effect that extracting the food waste has on the remaining composition of the residual waste stream that goes to EfW, was taken into account.

Option 4 Separate textiles collection

Table C.4 Option 4 relevant policies

Policy document	Relevant focus and initiatives	Implementation
Resource & Waste Strategy	Separate collections for textiles by 2025, subject to consultation, with possible extension of HWRC services to include textiles recycling.	Potential to be mandatory
Mayor of London's Environment Strategy	Aim to maximise recycling rates targeting materials with high embodied carbon (plastics, metals and textiles).	Regional level aspiration

Under option 4 a separate textiles collection was modelled, with the textile waste stream being treated separately to all other streams. Reuse of textiles was prioritised in the future as they are carbon intensive materials. There may be an EPR for textiles but it is likely local authorities will be encouraged to collect textiles separately in the future to enable reuse in the textile industry and for charities.

A kerbside collection of textiles has been assumed, collecting in kerbside bags, which may be relatively easy to add to the existing collection service, vehicle dependant.

Option 5 Reduction of packaging waste (DRS assessment)

Table C.5 Option 5 relevant policies

Policy document	Relevant focus and initiatives	Implementation
Resource & Waste Strategy	EPR of packaging by 2023, subject to consultation; eliminate avoidable plastic waste; removal of certain single use plastics; Deposit return scheme (DRS); public water refilling points to reduce plastic bottle consumption	EPR will be mandatory
Mayor of London's Environment Strategy	Focus on cutting single-use packaging and food waste by 20%; trialling a DRS for drinks containers, while government decides what it will do at a national level.	Regional level action/aspirations
Wandsworth Environment & Sustainability Strategy 2019 - 2030	Target set for 50% reduction in all single use plastics from Council operations (2019 – 2021).	Council level target

Under option 5 a reduction in packaging waste was modelled through a DRS based assessment.

As extended producer responsibility (EPR) is still in the consultation stage with no final conclusions available, and due to there being limited data available to inform a service level impact (i.e. the reform will impact the service from a funding point of view as well as potential packaging diversion from residual waste however the scale of impact for each is uncertain), it was agreed with the Authority to exclude this impact from the options modelling.

As option 1 considers a reduction in single use packaging, we focused on just drinks containers in this assessment as this will show the specific changes following implementation of a DRS.

Option 6 Low carbon transport options

Table C.6 Option 6 relevant policies

Policy document	Relevant focus and initiatives	Implementation
Mayor of London's Environment Strategy	Mayors Environment Strategy - expects LAs to use fewer and cleaner lorries to transport waste. They must demonstrate how they will transition their waste fleets to low or zero emission options, prioritising the phasing out of diesel. The overall ambition is that all heavy vehicles will be fossil free from 2030, with zero emission fleets by 2050. Fossil-fuel free can include the use of 100 per cent renewable fuels derived from sources such as food waste and waste oils.	Regional level aspiration/action
(Lambeth) Corporate Carbon Reduction Plan	Put electric vehicle infrastructure in place, using low-emission vehicles when necessary. Only ultra-low emission vehicles will be able to be leased by 2022.	Council level action
Wandsworth Environment & Sustainability Strategy 2019 - 2030	Reduce emissions of vehicle fleet with a roll out of low emission fleet vehicles with a plan for all Council vehicles to be powered by electric or renewable fuel sources by 2030.	Council level action/aspiration

Policy document	Relevant focus and initiatives	Implementation
RBKC Air Quality and Climate Change Action Plan 2016 - 2021	Work with their waste contractor to reduce emissions from its fleet and improve their operations with a target of 35% reduction versus 2007-2008.	Council level action/aspiration

Under option 6 alternative transport options were modelled, and this included the use of 100% electric vehicles. We understand diesel powered barges are used for residual waste and the contractor is looking at cleaning up their emissions, so the focus of the study is on the HGVs and other refuse vehicles used.

Option 7 Alternate weekly collections (AWC)

There are no relevant policies relevant to this option, but this collection system is commonly used by Local Authorities in England. As evidenced through previous modelling work Wood has undertaken for a number of local authorities, when the collection frequency is reduced a reduction in the number of vehicles on the road and in-service costs are observed. We would therefore expect to see a reduction in carbon. Indirectly, AWC has been linked with an increase in recycling and a potential reduction in residual waste. The waste flows relating to a change of service to AWC has already been modelled, and the impact of AWC on the collection resources and costs is being appraised for street level properties as we recognise this is unrealistic for flats.

Option 8 Separate Garden Waste Collection

Table C.7 Option 8 relevant policies

Policy document	Relevant focus and initiatives	Implementation
Resource & Waste Strategy	It is currently being consulted whether households with gardens should have access to free garden waste collections.	Potential to be mandatory

A separate garden waste collection was modelled for the constituent Councils. The effect that extracting the garden waste has on the remaining composition of the residual waste stream that goes to EfW, will be taken into account.

Appendix D

Option Modelling Assumptions

Table D.1 Option modelling assumptions

Policy or Authority driven	Assumption	Evidence/data
Option 1 Waste reduction per capita: An overall reduction in waste will be modelled (assumed only applicable to households)		
Council/WRWA driven	• The average trend of waste arisings (assumed reduction) over the last five years continues into the future • 2019/20 yield/hh data was used as the starting point for the projections	Data trend
Government policies/Council/WRWA driven	• 20% reduction in food waste by 2025 using a 2015 baseline (Courtauld Commitment)	Target
Government policies	• Removal of single-use plastics (SUP) - 25% reduction in 'carrier bags', 'other non-packaging wrap and film' and 'polystyrene'; reduction achieved by 2030 and applied to the 2019 yields • No reduction in PTTs; plastic appears to be the best material for the items contained in these, e.g. yoghurt, butter, dairy	Unsure of impact, non-quantifiable assumption, educated guess
Council driven	• 20% of households sign up to the Mailing Preference Service (MPS) with an average reduction in 77% of unwanted mail by 2030	Essex County Council case study
Option 2 Increase in recycling rate: An increase in the recycling rate considering wider remit as Councils continue to tackle contamination through interventions (assumed only applicable to households)		
Government policies/Council driven	• Households achieve a 35% recycling rate by 2025 and 40% by 2030, as opposed to households achieving 45% household waste recycling rate by 2025 (50% by 2030) as per the Mayors non-binding target • Note: 40% recycling rate with no organics recycling translates to incredibly high dry recycling capture rates which may not be realistic - the Councils that are not currently collecting food waste (Wandsworth and H&F) have therefore been modelled assuming that	Recycling rates of inner London Councils (Southwark currently are best in class at 35%)

Policy or Authority driven	Assumption	Evidence/data
	a food waste collection service is introduced by 2025, as well as full service roll out for Lambeth and RBKC.	
Government policies	• Continuation of comingled collection with no separation of materials, e.g. glass	Separating materials at the kerbside may be difficult in an urban setting and could cause storage issues for the households, so a simple approach whereby the current service continues has been assumed
Option 3 Separate food waste collection to AD/IVC vs Status Quo: A separate collection of food waste will be modelled with carbon impacts between AD and IVC assessed		
Government policies/Council driven	• No change in overall waste generated at household level or in the recycling rate of DMR and a food waste yield of 0.9 kg/hh/week for all Councils, to be in effect by 2023	WRWA data (food waste trials)
Option 4 Separate textiles collection: A separate textiles collection will be modelled, with the textile waste stream being treated separately to all other streams		
Council driven / Government Policies	• Textile yield of 1.1kg/hh/yr	LB Bexley textiles collection service trial
	• Textiles collection commences in 2022; collections would either be carried out by existing rounds (given the low yields) or collected by charities	
	• Income rate based on average of 2019 textile banks textile prices: £185/tonne • Saving of £154 per tonne in disposal plus £28 per tonne for textiles wrongly placed in the comingled recycling sacks	LetsRecycle 2019 data
Option 5: Reduction of packaging waste: a reduction in packaging waste would be modelled through a DRS based assessment.		
Government policies	• DRS 'all-in' option in 2023 and that 85% of the following materials are transferred from kerbside recycling and refuse waste collections to DRS recycling collections: PET drinks bottles, steel and aluminium drink cans and glass drinks bottles • The remaining 15% goes to kerbside • Saving of £154 per tonne in disposal and £28 per tonne for all materials retrieved through DRS	Defra EPR impact assessment

Policy or Authority driven	Assumption	Evidence/data
Option 6: Low carbon transport options: Alternative transport options would be modelled, and this could include one of the following: 100% electric/hybrid; Biomethane from food waste/waste oil; Ultra-Low emission vehicles, e.g. euro6 compliant		
Government policies/Council driven	• On basis of recent trials, electric vehicles to be used in any future vehicle change	Trend
Option 7: Alternate Weekly Collections (AWC)		
Council driven	• Applicable to kerbside properties only • Evidence from WRAP on reducing frequency of collections (+11% in dry recycling capture compared from moving residual waste to fortnightly from weekly)	WRAP research
Option 8 Separate Garden Waste Collections		
Government policies/Council driven	• Applicable to kerbside properties only • Lambeth participation/ service take-up rate of 6% of the street level properties • Projected kerbside yield of 95.6 kg/hh/yr per household participating • Maximum level of participation level reached in year 3/4 from the introduction of the service	Lambeth data

Appendix E

Typical Costs and Details for Electric Vehicles

Vehicle Type	Purchase cost (electricity)	Mpg	KgCO2e emissions per mile	KgCO2e emissions saved per mile compared to diesel
26t RCV (single compartment)	£380,800	0.4	0.8	2.1
26t split back RCV (50:50)	£404,600	0.4	0.8	2.1
7.5t RCV	£214,200	0.7	0.4	1.1
Food waste vehicle	£154,700	1.2	0.2	0.6



Western Riverside Waste Authority – Carbon Metric Report

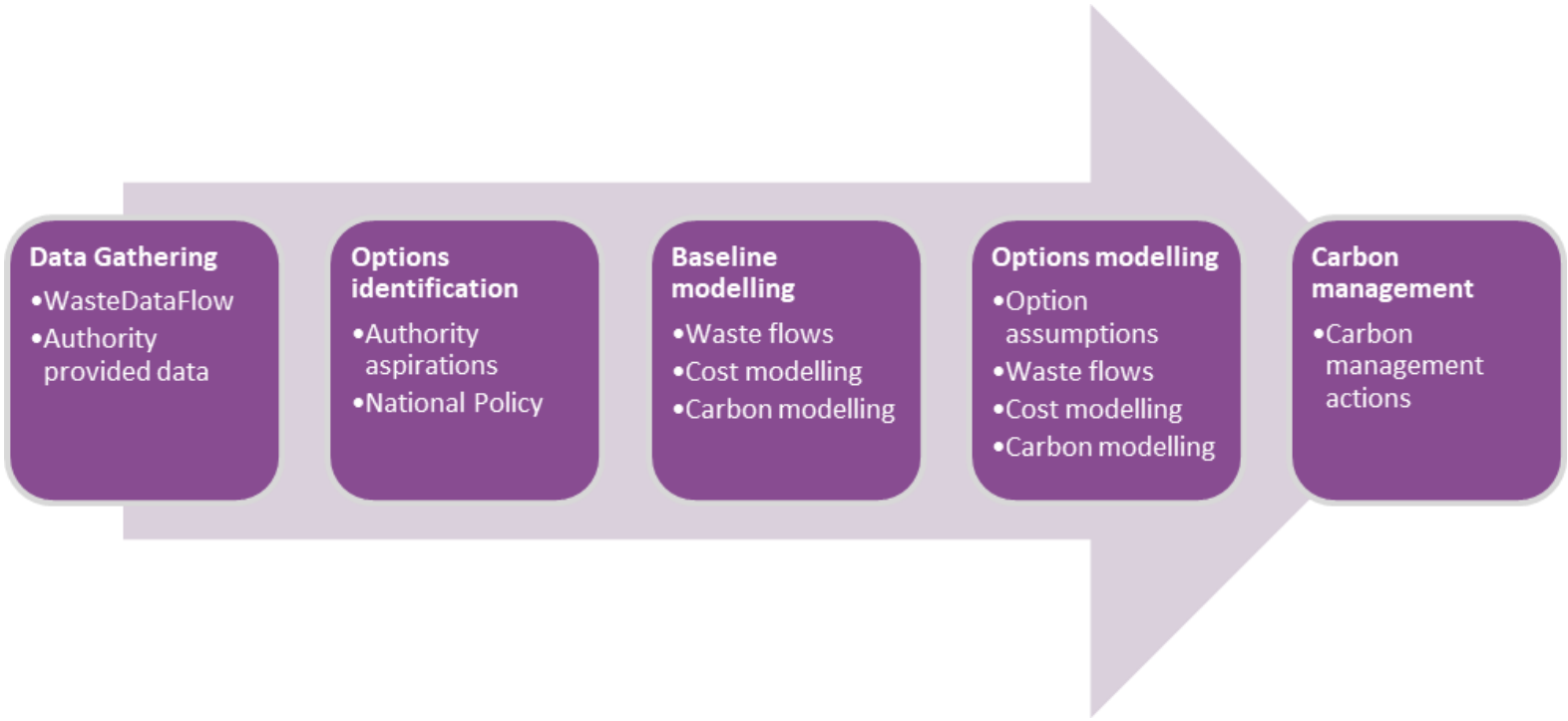
Richard Garfield
Jennifer Allen
Kostas Patapatiou

Project requirements

- Assessment of the carbon impact of waste management activities
- WRWA and Borough level
- Historical and projected future trends
  - Composition
  - Tonnage
  - Carbon emissions
- Review of collections and treatment / disposal
- Recommendations to improve carbon performance
- In support of a new Joint Waste Policy and Strategy

This presentation focuses on the WRWA level

Delivery approach



Key Performance Indicators

- The following KPIs were agreed as being appropriate for the Authority to monitor:
  - Recycling rate
  - Waste minimisation
  - Cost per tonne of waste managed
  - Vehicle Greenhouse Gas (GHG) emissions
  - Total GHG emissions per household

Options identification

- Informed by national and local policy and strategies
- Agreed options:
  - Option 1: waste reduction per capita
  - Option 2: increase in recycling rate
  - Option 3: Separate food waste collection to AD/IVC vs Status Quo
  - Option 4: Separate textiles collection
  - Option 5: Reduction of packaging waste (Deposit Return Scheme (DRS) assessment)
  - Option 6: Low carbon transport options
  - Option 7: Alternate weekly collections (AWC)
  - Option 8: Separate garden waste collection Vs the Status Quo

Baseline modelling

Modelling approach

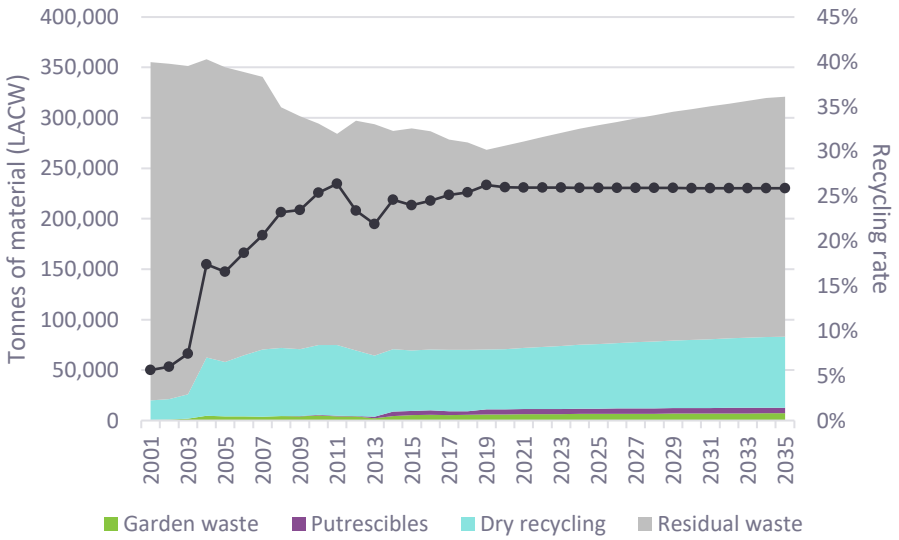
- Baseline and historical trends
- Data primarily taken from WasteDataFlow (WDF) and supplemented by Authority provided data.
- From this base data that modelling parameters were developed (e.g. recycling yields) and approaches to filling gaps in existing knowledge, using informed assumptions, as agreed.
- Local and/or Authority-specific data used in preference to alternative data sources and/or default values to ensure baseline model as representative as possible.

Baseline modelling

BASELINE – Status quo

Assumptions:

- Waste generation per capita remains constant at current levels
- Waste arisings therefore increase in accordance with projected increases in population
- No change in waste composition or recycling performance



Headline results:

- Increase in total waste arisings – linked to population
- Recycling rate remains at current levels

Baseline performance and cost

KPI	WRWA	H&F	RBKC	Lambeth	Wandsworth
Kerbside recycling rate	26%	25%	27%	32%	22%
Cost per tonne	£178.27	£50.82	£77.85	£41.80	£43.71

- Recycling rate for household collected waste
- Cost per tonne is across household and non-household collected waste
- WRWA rate is the average of constituent Authorities

WRATE modelling

- Modelling of carbon and environmental impacts
  - Collection through to treatment / disposal
    - Containers
    - Collection vehicles
    - WTS and MRF
    - Recyclate management
    - Treatment and disposal
- Baseline model developed against which option impacts can be measured
- Historical and future trends (against baseline position)
- Benchmarked against a ‘no waste’ position

Baseline carbon impact (WRATE modelling)

	WRWA	H&F	RBKC	Lambeth	Wandsworth
Containers	1,740	300	338	566	536
Waste Collection	3,394	368	1,067	932	1,027
WTS & MRF	976	176	157	245	399
Recycling	-72,616	-13,544	-11,286	-12,949	-34,838
Treatment (EfW/AD/IVC)	3,955	1,006	1,166	2,063	-279
Landfill	24	5	4	6	10
Total	-62,526	-11,689	-8,554	-9,138	-33,145
Households	533,119	102,673	98,733	162,265	169,448
KG CO_2/HH/Yr	-117.3	-113.9	-86.6	-56.3	-195.6

Baseline carbon impact (WRATE modelling)



- Reduction from 2002 shows progress in recycling and a move from landfill to EfW
- 2015 – 2019 increase due to changes in EfW electricity offset benefit

Options modelling

Waste Flows

Historical and future data modelling

Operational & cost assumptions obtained from constituent Councils

Baseline models developed (from 2002 to present)

Baseline waste flows projected to 2035 (using hh & population projections)

Option models developed by applying sets of assumptions on baseline flows

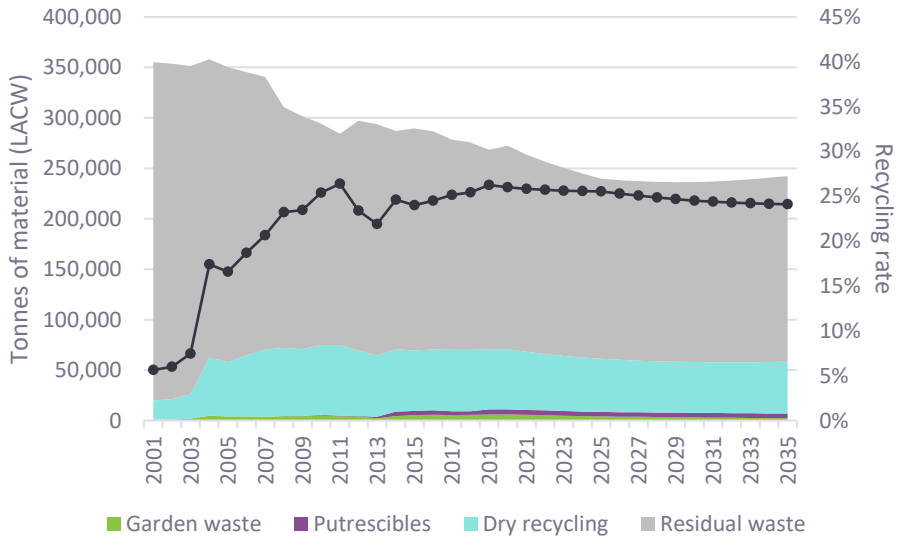
All assumptions were developed and agreed with WRWA

Options modelling

OPTION 1 – Waste reduction per capita

Assumptions:

- Waste reduction trend of last 5 years continues
- 20% reduction in food waste by 2025 (2015 baseline) – Courtauld Commitment
- 25% reduction in single use plastics by 2030 (2019 baseline)
- No change in PTT yields
- 77% reduction in unwanted mail by 2030 – Essex County Council case study



Headline results:

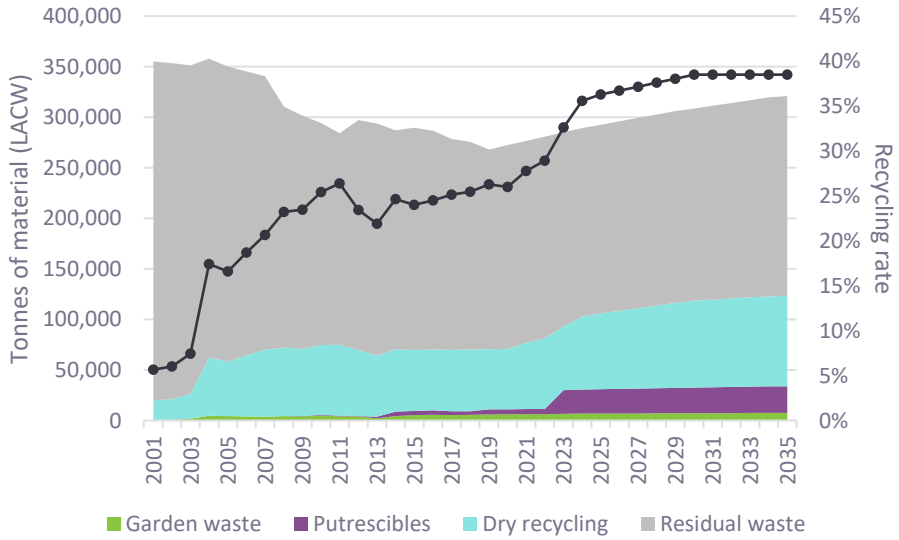
- Significant reduction in overall waste arisings (c. 80,000 tonnes in 2035 compared to baseline)

Options modelling

OPTION 2 – Increase in recycling

Assumptions:

- Households achieve a recycling rate of 35% by 2025 and 40% by 2030
- Increase in recycling includes separate food waste collections (otherwise unrealistically high dry recycling capture rates would have to be assumed)
- Capture rate capped at 85%
- Comingled collections continue



Headline results:

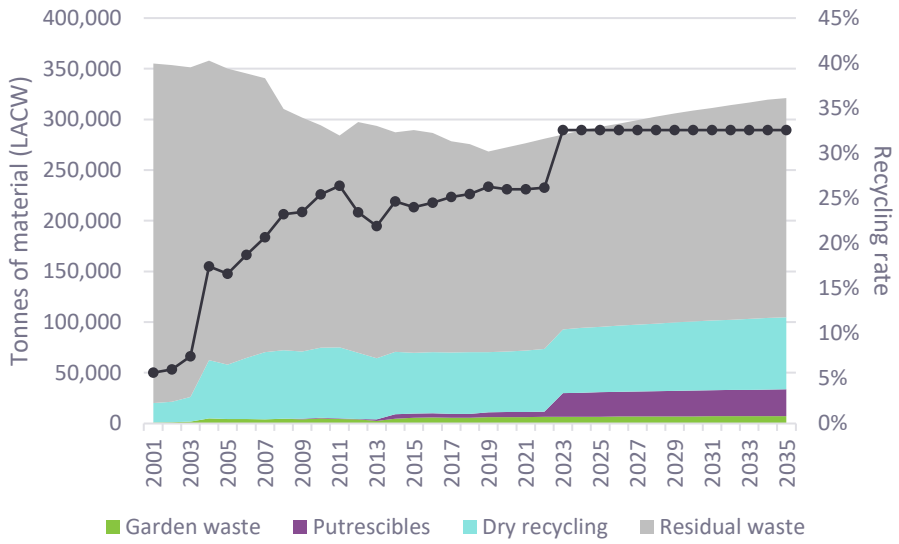
- Significant increase in recycling rate, reaching c. 40% by 2030 (slightly less than target due to capture rate cap)

Options modelling

OPTION 3 – Separate food waste collection

Assumptions:

- A food waste yield of 0.9 kg/hh/week is achieved by all authorities by 2023 – WRWA food waste trials
- No change in overall waste generation
- No change in collection methods of residual waste, dry recycling and garden waste



Headline results:

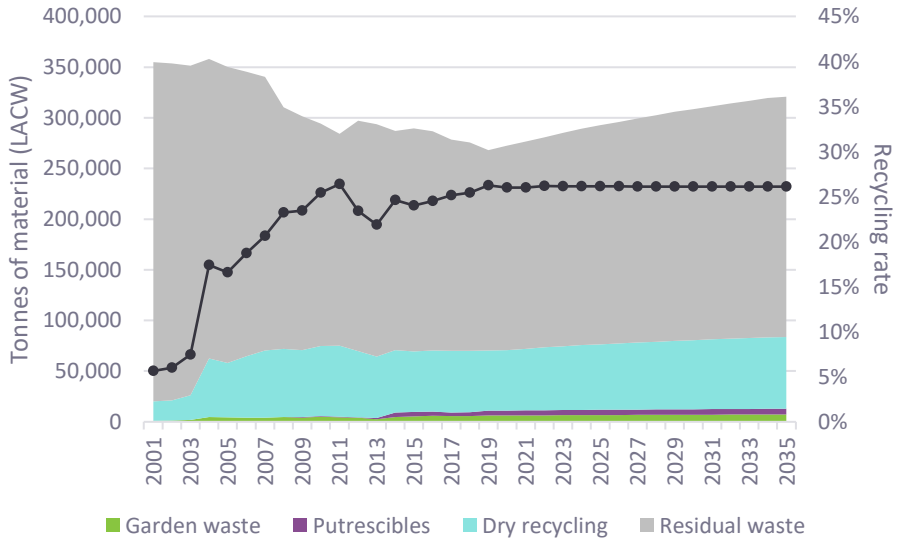
- Notable increase in recycling rate, reaching c. 33% in 2023
- Recycling rate plateaus afterwards

Options modelling

OPTION 4 – Separate textiles collection

Assumptions:

- A textile yield of 1.1 kg/hh/year is set-out for collection by households on average – LB Bexley trial
- Textiles collections commence in 2022



Headline results:

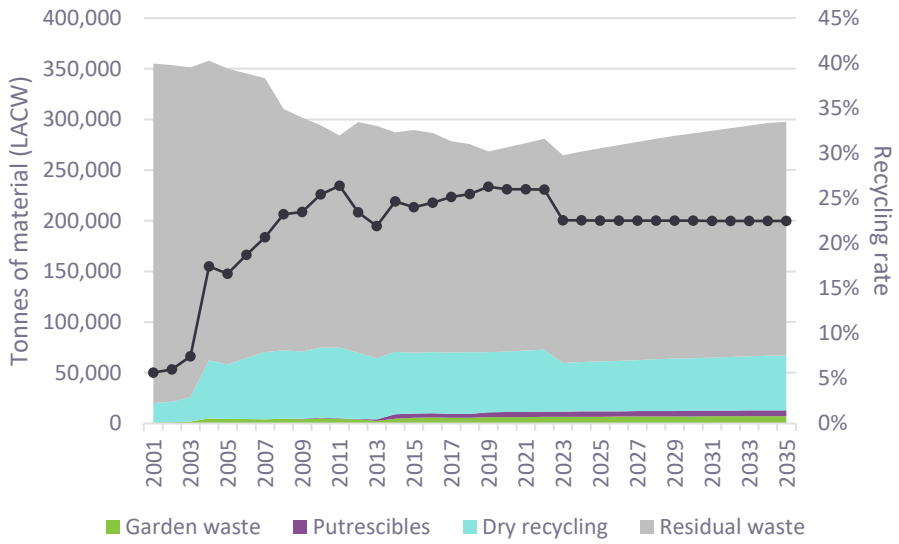
- Minor impact on recycling rate, since textile tonnages collected are negligible compared to total arisings

Options modelling

OPTION 5 – Reduction in packaging waste

Assumptions:

- DRS 'all-in' option comes into effect in 2023
- 85% of PET drinks bottles, stell and aluminium drinks cans and glass drinks bottles are transferred from the kerbside to the DRS collection systems
- 15% of these materials remains in kerbside collections



Headline results:

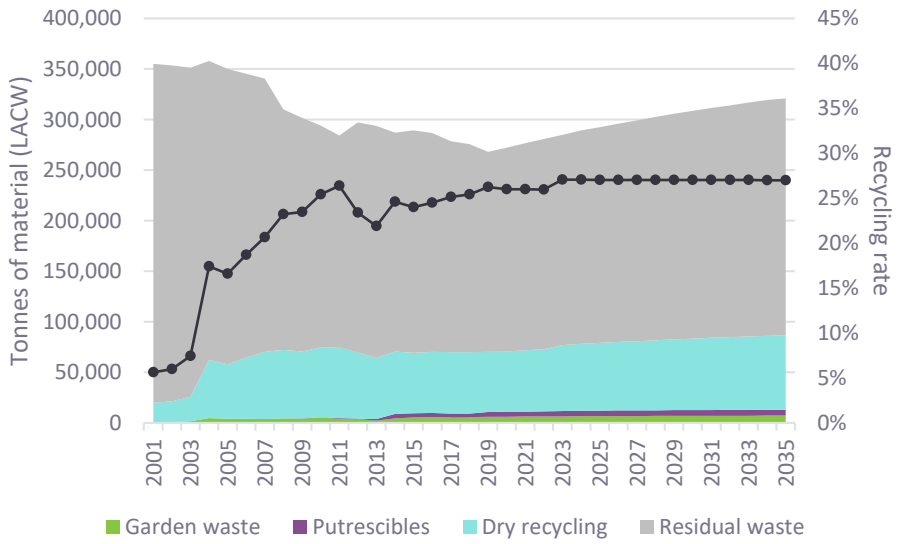
- Reduction in total waste arisings by c. 23,000 tonnes
- Reduction in recycling rate by c. 3% (key recyclable materials removed from system)

Options modelling

OPTION 7 – Alternate weekly collections

Assumptions:

- Applicable to street level properties only (i.e. flats will likely need to retain weekly service)
- +11% in dry recycling capture from reducing the frequency of residual waste collections from weekly to fortnightly – WRAP evidence



Headline results:

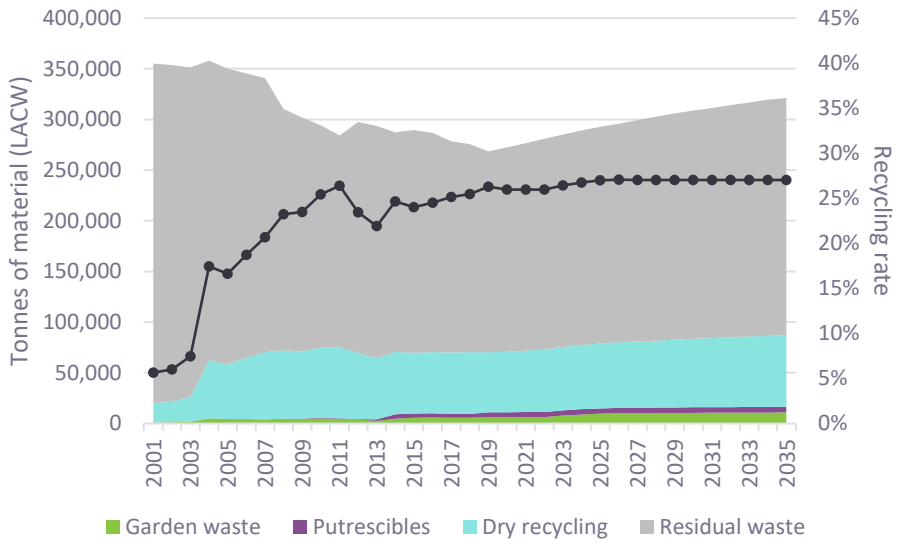
- Marginal increase in recycling rate by c. 1% (impact not applied to flats; some authorities already implement AWC collections so no improvement there)

Options modelling

OPTION 8 – Separate garden waste collections

Assumptions:

- Applicable to street level properties only
- 6% of street level properties take up the service
- Kerbside garden waste yield of 95.6 kg/hh/year per participating household
- Max level of participation reached in year ¾ from the introduction of the service



Headline results:

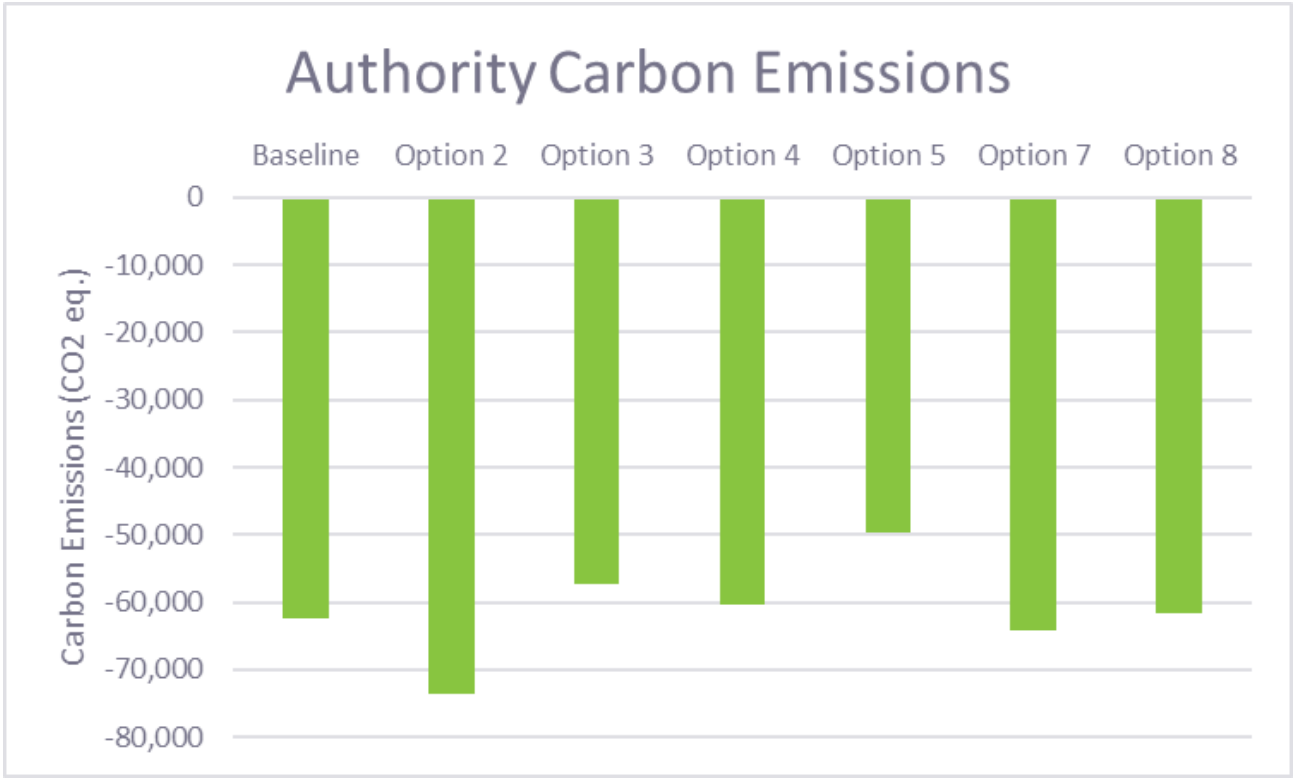
- Marginal increase in recycling rate by c. 1% (impact not applied to flats; some authorities already implement garden waste collections)

Carbon modelling outputs

Carbon modelling outputs

- WRATE
  - Does not effectively represent waste reduction benefits as it considers facility capacities being reached
  - Does not allow for electric vehicle impacts to be assessed
    - Estimated based on supplier information
    - 75% emission reduction
  - Presents a reduction of carbon emissions as a negative figure

WRATE modelling outputs



- Option 2 (increasing recycling rates) leads to the lowest carbon impact with Options 7 (AWC) also providing additional benefits
- Trends are similar across individual Authorities

WRATE modelling outputs

	Baseline	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Containers	1,740	1,815	1,823	1,740	1,740	1,740	1,740	1,740
Collections	3,394	4,046	4,048	3,392	3,391	763	2,095	3,403
Intermediate Facilities	976	875	890	887	827	976	974	975
Recycling	-72,616	-82,801	-70,383	-72,589	-60,574	-72,616	-73,713	-72,385
Treatment	3,955	2,510	6,304	6.088	4,861	3,955	4,596	4,499
Landfill	24	18	21	22	21	24	24	24
Total (tpa CO2 eq.)	-62,526	-73,537	-57,297	-60,460	-49,734	-65,157	-64,283	-61,743

- Collections, recycling and waste treatment have the most significant impacts on waste service carbon emissions
- The movement of food waste from EfW to AD (Option 3) results in a worse overall carbon position
- The impact of CHP at Riverside is a carbon saving of c. 4,000 tpa for every 5% reduction in electricity production due to heat offtake

Findings

Option KPI Summary

KPI	Baseline	Option 1 (WM)	Option 2 (RR)	Option 3 (Food)	Option 4 (textiles)	Option 5 (DRS)	Option 6 (EVs)	Option 7 (AWC)	Option 8 (Garden)
Recycling rate	25%	25%	38%	32%	26%	22%		27%	27%
Waste minimisation (against the baseline)		72,408t				22,216t			
Cost per tonne of waste	£178.27			£182.32				£171.06	£177.96
Vehicle GHG emissions (T)	3,394	3,388	4,046	4,048	3,392	3,391	763	2,095	3,403
GHG emissions per HH (% diff to baseline)	-117.3 kg/hh	-	-17.8%	8.4%	3.3%	20.5%	-5.0%	-2.8%	1.3%

Presentation by Wood.

Carbon Management Strategy

Carbon management strategy

- Climate Emergency declarations
- Strategic level carbon assessment – short/medium term actions (Carbon organisation and operational boundaries)

Category	Emission source
Offices	Electricity, gas, water, waste, material use
Workshops	Electricity, gas, water, waste, material use
Fleet	Fuel, business miles
Containers	Numbers, material use

Carbon management – next steps

- Detailed Cost Benefit Analysis
- Consider Council's budget provisions, procurement schedules and strategic aims
- Schedule for implementation of schemes
- Development of SMART targets

wood.

Any Questions?

Thank you


wood.

Questions		
Lambeth	**Response**	**Column1**
To confirm: emissions are modelled as avoided emissions compared to sending waste to landfill rather than actual emissions of the EfW incinerator or recycling facilities?	WRATE modelling calculates the actual lifecycle emissions of the materials based upon their end of life destinations and management approaches. The calculation is not comparative to sending material to landfill. Negative emissions are the result of offsetting more harmful actions.	
How do 'negative emissions' from recycling fit strategically with reaching net zero targets by 2030, considering that options which minimise waste are shown to have smaller negative emissions (i.e. lower carbon benefit) than those which don't? It would be of real benefit if the emissions models were based on actual real world Cory/WRWA data and fuel consumption, please provide info on whether this is the case and where real vs averaged data has been used.	WRATE carbon emission calculations do not consider the "scope" boundaries that are used in carbon reporting, they are based on the lifecycle assessment of the materials. The emissions and impacts of the various processes would be allocated amongst various organisations in a formal carbon reporting assessment. The modelling has been undertaken using the most appropriate standard technologies from within the WRATE model, this is entirely appropriate for undertaking this type of modelling. WRATE is a strategic modelling tool drawing on a complex and extensive multifactor assessment of the impacts of processes. Without access to the detailed (commercially confidential) information associated with the various processes it would not be possible to undertake a completely bespoke assessment, and if that information were available more appropriate tools are available to undertake a real life carbon impact assessment.	
Were the cost assumptions just based on e-vehicle prices or were charging infrastructure and grid upgrade costs also taken into account?	Prices were just for the purchase of the electric vehicle.	
Re Option 3: The report finds that emissions would increase due to implementation of separate food waste collections compared to sending food to EfW. However, p85 states that the National Resource Strategy "references that AD represents best environmental outcome for food waste that cannot be prevented" – why is there are an apparent contradiction here?	AD is the most beneficial approach to the treatment of the food waste when considered in isolation, however the benefits from any potential reduction in residual collection mileage as well as the addition of the impacts associated with the collection, bulking, onward transport and management of the digestate needs to be considered in the specific assessment of whether a change in management approach is beneficial. The assessment in this case suggested it was not.	

Wandsworth	Response	Column1
A Zero Waste Scotland style table breakdown of emissions for different materials, their generation and treatment processes would have been useful to highlight where the big impacts/savings & further potential reductions lie. ZWS style analysis highlights how the CO2eq benefits associated with waste reduction are generally large compared to those associated with improving its treatment.		
"For example, whilst Option 3, the separate collection of Food Waste to Anaerobic Digestion (AD), results in an overall increase in atmospheric carbon equivalent emissions across the Authority's area, conversely in Lambeth, which sends organic waste to In-Vessel Composting (IVC), it would have a positive impact as AD treatment has a greater carbon benefit than IVC, due to the associated production of electricity.": Doesn't Lambeth's food waste service increase its CO2eq impacts as a result of sending it to IVC? "Positive impact" may be confusing in this context.	No not compared to the status quo. It is demonstrating that if Lambeth sent its food waste to AD as opposed to where it sends it currently, namely IVC, that there will be a positive impact in terms of decreasing the carbon impact. If Lambeth did not collect separated food and garden waste and it was all collected as residual waste there would be a greater carbon benefit. This is based around the full life cycle analysis, the collection process, treatment and containers.	
Surely PTTs are not best for butter- most is in paperised foil- what's wrong with that? Only spreadable butter needs PTTs but that's a blend of butter & veg oil, not pure butter as such. (yes, I'm being pedantic!)	Noted. It is the Government's decision not to treat PTT's as single-use.	
Option 1 modelling of 22,937 tonnes of waste reduction for Wandsworth (by 2025?) seems unrealistically optimistic.	The waste reduction tonnages were calculated from comparing option 1 with the baseline in 2030. This is based on the trend in waste reduction over the last 5 years, as well as the other assumptions listed in 5.3.2 e.g. food waste reduction and single use plastics reduction.	
Is Option 3 assumption of 0.9kg food waste recycled per household for all households or just low-rise?	Only low rise.	
For Wandsworth, the best case scenario at present is low-rise households only from April 2024.	Noted.	
Does Option 3 model the food waste reduction impact of introducing food waste recycling? This is where any associated carbon reduction benefits are likely to be.	The food waste trials undertaken by RBKC did not show any correlation between introducing a food waste collection service and a consequent reduction in overall tonnages. There was no impact.	
Option 4 is effectively part of the baseline scenario- Traid offer free collections from the door on request & Wandsworth promotes this service- that's one reason why its textile recycling figures are comparatively good. However the tonnage collected via this service only equates to c. 0.18kg/hh/year.	Yes the .18kg/hh/year would be included in the baseline scenario. However, the waste composition survey carried out in January 2020 revealed that there is still 0.20kg/hh in Wandsworth's residual and .05kg/hh in the recycling stream, (contamination). A total of .25kg/hh of textiles.	
Option 5 is only realistic in the absence of a unique QR code system enabling deposits to be reclaimed whilst continuing to use LA recycling services.	Noted	
Option 7 assumption is +11% on dry recycling from switching to AWC but as Wandsworth's low-rise dry recycling performance is relatively good, the boost may be lower than this standard WRAP figure.	Noted.	
The Option 8 assumption of 95.6kg garden waste composted per subscriber is conservative compared to Resource Future's figure of 240.1kg in their 2016 report for Wandsworth commissioned by Resource London.	Noted	
How realistic is the 75% reduction in emissions for electric collection vehicles and is this figure for usage only? If so, what would the whole life-cycle percentage saving be (taking into account production impacts, need for more vehicles due to battery weight & reduced payload? (I've previously seen a 9% lifecycle saving figure for an electric supervisor van compared to diesel but the Grid has greened significantly since then).	This level of detail has not been looked into. There is no electric vehicle option within WRATE. 75% reduction in carbon emissions based on standard electricity mix. The evidence we are seeing is that there is not a materially reduced payload and vehicles are more efficient for stop/start driving and typically have a longer life span.	
The report appears to ignore the potential carbon benefits of (i) combined heat & power EfW; (ii) carbon capture EfW & (iii) pre-sorting of fossil plastics in residual waste (diverting them to landfill if they can't be recycled?). Given the limited carbon benefits of the modelled scenarios this may be where the carbon reduction focus needs to lie.	Noted. (i) is covered in the report	

RBKC	Response	Column2
Would it be possible to get a breakdown of the emission factors used for recycling/disposing of different materials? I'm sceptical about the negative figure applied to recycling, as does that not make it better than waste reduction?	It does not. Within WRATE recycling has a better benefit than reuse due to the boundaries that the assessment is undertaken on, this limitation is recognised within the report. WRATE does not take account of the emissions associated with the production of an item and it's use only the material within it hence the underrepresentation of re-use. However the benefits associated with the recycling were assessed and audited by the Environment Agency during the development of the tool.	
1)Are the emission factors consumption based i.e. include CO2e/tonne assumptions based on where and how the waste was produced.	The model is compositional based, it prescribes no assumptions to the materials managed beyond the quantity and composition, all other modelled aspects are defined in the modelling process.	
2) Do the emission factors have built in assumptions around how material is transported?	The transport of material is an element of the assessment that has to be entered appropriately into the model.	
Ideally we would like to see emission factors that don't contain number 1) or 2) above, as this will allow us to model future scenarios ourselves, such as increasing food waste rounds, while reducing waste and recycling rounds, at the same time.	We have assessed the overall carbon impact using WRATE and provided the outputs. Emission factors were not part of the scope.	

Additional work	Where lifecycle analysis (i.e. use of WRATE) is not required, other carbon modelling tools exist.
Lambeth request	**Response**
It would be useful to see some modelling of all options combined or scenarios where more than one option is implemented (as will likely be the case) – we would like to see the impact of each option on the others, for example electric vehicles, AWC and per capita waste reduction in all scenarios.	This would require re-modelling of the waste flows to combine options, followed by remodelling within WRATE. WRATE does not have an electric vehicle option - this was calculated outside of WRATE.
Is it possible to add emissions to the tonnage graphs for each option to show the relationship between them?	We have not calculated emission profiles over-time so it is not possible to overlay these onto tonnage graphs.
For vehicles, can any modelling be done with other fuel types such as HVO?	WRATE does not have a vehicle option using alternative fuels.
RBKC request: Is it possible get a breakdown of the following:	**Wood response**
1a) CO2e/tonne produced from burning food waste at Cory's EFW plant, including energy required to run the plant, e.g. grid electricity, gas oil and mains water. •This is needed not as an overall, average figure for all waste but just for food waste. Food waste should have a low figure because it is biogenic and so the CO2 emitted from burning it will be 0 (but there will still be CO2 produced from the energy powering the plant)	Bespoke modelling assessment would be required as WRATE only provides emission profiles for standard EfW, i.e. not specific to Cory. The contractor should be able to provide some information on energy consumption although this may be confidential information.
1b) CO2e/tonne reduced, by burning food waste at Cory's EFW plant, generating energy, and therefore avoiding alternatives such as fossil fuel in the electricity grid. •This is needed not as an overall, average figure for all waste but just for food waste. •This is needed over a period of time e.g. 5, 10, 15 and 20 years, and will need to account for predicted decarbonisation of the grid	Bespoke modelling assessment would be required as WRATE only provides emission profiles for standard EfW, i.e. not specific to Cory. WRATE can take into account a user defined energy mix.
2a)CO2e/tonne produced from processing food waste at Biocollector's AD plant in Mitcham, including energy required to run the plant, e.g. grid electricity, gas oil and mains water. •This needs to include the methane produced and energy required to run the plant.	Bespoke modelling assessment would be required as WRATE only provides emission profiles for standard AD plant, i.e. not specific to WRWA. The contractor should be able to provide some information on energy consumption although this may be confidential information.
2b)CO2e/tonne reduced, by processing food waste at Biocollector's AD plant in Mitcham, generating energy, and therefore avoiding alternatives such as fossil fuel in the electricity grid. •This is needed over a period of time e.g. 5, 10, 15 and 20 years, and will need to account for predicted decarbonisation of the grid •Any additional CO2e/tonne from using food waste as a fertiliser	Bespoke modelling assessment would be required as WRATE only provides emission profiles for standard EfW, i.e. not specific to WRWA. WRATE can take into account a user defined energy mix.
3a)CO2e/tonne from collecting general waste and recycling from RBKC households and delivering it to WRWA. •Also include what would be the impact with electric vehicles	Revised WRATE assessment or other carbon modelling tool assessment. Electric vehicles are not a vehicle option within WRATE but an assessment could be made.
3b)CO2e/tonne from transporting general waste on the barge from WRWA to Riverside	This information should be available from the operator of the barges for Diesel and then would need to use conversion factor for diesel to electric.
4a)CO2e/tonne from collecting food waste from RBKC households and delivering food waste to Transport Avenue •Note – can use data from the one vehicle round we currently have •Also include what would be the impact with electric vehicles	Revised WRATE assessment or other carbon modelling tool assessment (i.e. does not need to use WRATE lifecycle tool). Electric vehicles are not a vehicle option within WRATE but an assessment could be made.

4b) CO2e/tonne from transporting food waste from Transport Avenue to Biocollector's AD plant in Mitcham -Also include what would be the impact with electric vehicles	Revised WRATE assessment or other carbon modelling tool assessment. Electric vehicles are not a vehicle option within WRATE but an assessment could be made.
5a) CO2e/tonne produced from processing each tonne of dry mixed recycling at the MRF e.g grid electricity, gas oil and mains water.	The MRF Contractor should be able to provide this information.
Where applicable, the impact of electric vehicles on the above factors should also be taken in to consideration. I would also add, regarding the part in relation to transportation and electric vehicles, that the whole RBKC waste fleet has been operating ULEZ compliant vehicles since the beginning of the year. They produce less CO2 and so this will require factoring in.	