Greenhouse Gas Emissions Performance Standard for London's Local Authority Collected Waste – 2013/4 Update

The Greater London Authority

Adam Baddeley
Ann Ballinger
Simon Hann

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Report for Adam Batchelor

Prepared by Ann Ballinger and Simon Hann

Approved by

Adam Baddeley, Principal Consultant

(Project Director)

Eunomia Research & Consulting Ltd
37 Queen Square
Bristol
BS1 4QS

United Kingdom

Tel: +44 (0)117 9172250
Fax: +44 (0)8717 142942

Web: www.eunomia.co.uk

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1.0 Background and Introduction

The greenhouse gas (GHG) emissions performance standard (EPS) forms a core element of the Mayor of London's Municipal Waste Management Strategy (MWMS).

Following an initial draft released for public consultation in 2010, the EPS in its final form was published along with the Mayor of London's MWMS in July 2011. In addition to setting the EPS for the years 2015, 2020 and 2031, the report presented the performance of London's local authorities against the EPS for the years 2008/9 and 2009/10. This update presents information on London's performance against the EPS during 2013/14 and builds on the previous updates for 2010/11, 2011/12 and 2012/13.

Two of the key principles within the MWMS can be summarised as:

1) Encouraging a focus on recovering materials and reprocessing routes, which deliver greater CO_2e reductions; and
2) Providing support for decentralised energy generation from waste that is no more carbon intensive than the alternative form of new base-load energy generation.

To deliver upon these two principles, Eunomia developed both a 'whole waste system' EPS and a carbon intensity 'floor' (CIF), which applies solely to energy generation from waste.[1] It should be noted that this update report relates to the former only.

For clarity, the GHGs falling within the scope of the EPS include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emitted during waste management activities including recycling, treatment, transport and landfill. For simplicity, and in line with global GHG accounting protocols, all non-CO_2 emissions are converted to CO_2 equivalents (CO_2e) for measurement against the EPS.

At present, the scope of the EPS provides for the inclusion of only a limited amount of reuse activity. This is primarily the carbon benefit associated with textiles recycling as a certain amount of re-use is assumed and incorporated the figure. It has not, thus far, been possible to incorporate waste prevention. This subject was discussed in detail in the 2011/12 report.

For the 2012/13 report the scope of analysis was extended to enable comparison of how London is performing against other similar cities within England such as Manchester and Birmingham and to look at comparisons with England as a whole. Consideration was also

[1] The GLA has developed a tool for London boroughs to model their performance against the EPS and CIF, which can be downloaded at www.london.gov.uk/priorities/environment/putting-waste-good-use/making-the-most-of-waste

given to the economic and market drivers which are currently influencing the performance of local authority waste collection and treatment across the UK.

This report provides a brief update on the performance of Birmingham and Manchester against the EPS in Appendix A.1.0 and repeats the analysis of economic and market drivers in Appendix A.2.0. Appendix A.3.0 presents an assessment of performance against the EPS at the level of each of the 33 London Boroughs, key results from which are also presented in Section 2.2.

2.0 Assessment of Performance in 2013/14

2.1 Net Emissions from Waste Management

This update on London's performance against the EPS was undertaken by incorporating data from Waste Data Flow (WDF) for 2013/14 into the existing EPS model for London.[2]

The results of this modelling exercise confirm that waste management emissions in London in 2013/14 have increased *marginally* (corresponding to a reduction in performance relating to London's emissions from waste management) from -114 thousand tonnes of carbon dioxide equivalent emissions per annum (ktpaCO_2e) in 2012/13 to -109 ktpaCO_2e.[3] To provide further context, there was a small improvement in performance of 45 ktpaCO_2e from the results of the previous year (2012/13) when these are compared with the performance for 2011/2012.[4]

It should be noted that since the EPS was implemented in 2011, London's CO_2e emissions from local waste management activities have fallen from 135 kt CO_2eq in 2008 (the first year the EPS results were developed) to -109 ktCO_2e in 2013/14.

A breakdown of the emissions from local authority collected (LAC) waste management in London is set out in Table 2-1. This data shows how emissions reductions provided by recycling activities in 2013/14 offset emissions from residual treatment and landfill to give an overall *net* figure – as has been the case for the past three years.

The information in Table 2-1 shows that the increase in emissions for 2013/14 compared with 2012/13 is the result of the following factors:

- A net increase in the total amount of residual waste treated. There was a small increase in waste going to landfill of 16 ktpa. This is the first time landfill tonnages have increased from one year to the next since the GLA began measuring performance against the EPS. Emissions from incineration also increased, which together with the increase in landfill has contributed to increasing the total net emissions from residual waste treatment by 8 ktpaCO2e (5 ktpaCO2e of which comes from the landfill impact); and
- A decrease in the collection of paper, glass and metals by 14, 4 and 1 ktpaCO2e respectively has resulted in a reduction in the dry recycling benefit of 8 ktpaCO2e. The benefits associated with recycling plastics and textiles continue to rise however,

[2] Environmental impacts were calculated using the Environment Agency's life-cycle assessment tool, WRATE

[3] This is a net reduction in climate change impacts, brought about by the 'displacement' effects of material recycling and generation of energy from waste. These activities result in lower emissions than would have otherwise taken place in manufacturing from raw materials and in energy generation from other sources

[4] As was indicated in Section 1.0 results presented here differ from those presented in previous years due to differences in the underlying WDF data

with increases of around 2 and 8 ktpaCO2e attributable to each material respectively. This has more than offset reductions in benefit for paper, glass and metals such that there has been a total net increase in recycling benefits of 2 ktpaCO2e.

The results for this year represent the first time since the original development of the EPS baseline data for 2008/9 that total waste arisings have increased from one year to the next (albeit only relatively marginally), perhaps reflecting a general improvement in economic conditions occurring in the past year. Residual waste arisings have also increased slightly since the previous year, continuing the trend of similar increases occurring over the past two years. However, total waste arising have still reduced from the initial baseline figures in 2008/9 which has resulted in a fall in emissions of 118%. This reduction in emissions is equivalent to that of the emissions associated with making 44,000 return flights from London to Sydney.

It is noted that the data on arisings derived directly from WDF differs from that published by Defra for the same period.[5] An attempt was made to reconcile the differences between these datasets during the development of Eunomia's Carbon Index. Ultimately, it was not possible to reconcile the two sources, as Defra undertakes some additional calculations and it was not always clear how these had been done. However, contact made with Defra during this process has confirmed that differences exist between, for example, the way that the various MBT streams are tackled in the Defra dataset and the way some LAs have reported the same data in WDF. This is most likely to be the reason as to why the sources are different with regard to residual waste arisings.

There was also an increase in the amount of source segregated organic material treated (from 321 kilotonnes in 2012/13 to 335 in the following year). These materials have a relatively low impact on the EPS score in comparison to the dry recyclables. The improvement in organics recycling has, however, contributed to offsetting some of the tonnage decrease in dry recyclables when the total tonnage of recycling is considered. As a consequence, there is only a slight decrease in the recycling rate from 2012/13 to 2013/14. The relatively significant increase in textiles capture (of around 20%) and the continued steady improvement in plastics capture have helped London to more or less maintain its EPS performance with respect to the dry recycling impacts, despite collecting 12 thousand tonnes less recycling than in the previous period.

Table 2-2 compares - in percentage terms – London's performance in 2013/14 to that of 2008/9. This shows that the biggest changes over the period are associated with residual waste treatment – a decrease in landfill alongside an increase in incineration and (to a lesser extent) MBT treatment, the amount of food waste treated at AD plant, and the proportion of plastics and wood collected for recycling.

[5] See https://www.gov.uk/government/statistical-data-sets/env18-local-authority-collected-waste-annual-results-tables

Table 2-1: London's 2008/09 Baseline EPS, and Performance for 2009/10 to 2013/14

Waste Management Activity	Waste Managed (ktpa) in 2008/09	Associated Emissions ($ktCO_2e$) in 2008/09	Waste Managed (ktpa) in 2009/10	Associated Emissions ($ktCO_2e$) in 2009/10	Waste Managed (ktpa) in 2010/11	Associated Emissions ($ktCO_2e$) in 2010/11	Waste Managed (ktpa) in 2011/12	Associated Emissions ($ktCO_2e$) in 2011/12	Waste Managed (ktpa) in 2012/13	Associated Emissions ($ktCO_2e$) in 2012/13	Waste Managed (ktpa) in 2013/14	Associated Emissions (ktCO2e) in 2013/14
Residual Waste												
Landfill	1,720	447	1,523	396	1,391	362	872	227	740	192	756	197
Incineration [5]	912	52	802	45	896	51	1,303	74	1,462	83	1,525	86
MBT [1, 4]	278	-3	296	-4	308	-4	319	-4	341	-4	336	-4
Organic waste												
Anaerobic Digestion	0	0	23	-2	28	-2	31	-3	45	-4	51	-4
In-vessel Composting	130	-6	133	-6	125	-6	154	-7	132	-6	141	-7
Open Air Windrow	148	-6	144	-6	150	-6	147	-6	144	-6	143	-6
Materials Recycling												
Paper / Card	355	-106	327	-98	344	-103	364	-109	369	-110	355	-106
Glass	130	-12	128	-12	125	-12	121	-11	125	-12	121	-11
Metals (ferrous)	34	-56	37	-59	32	-52	32	-52	32	-52	31	-51
Metals (non-ferrous)	15	-160	16	-168	14	-152	14	-150	14	-149	14	-147
Plastics	35	-42	44	-52	49	-58	52	-61	55	-65	57	-67
Textiles	10.8	-47	11	-48	8.4	-37	7.9	-34	8.6	-37	10.4	-45
Wood	34	0.03	64	0.06	73	0.07	69	0.07	68	0.07	72	0.07
Rejects [3]	244	22	366	44	320	30	271	23	182	13	145	13
Transport	N/A	52	N/A	50	N/A	51	N/A	45	N/A	44	N/A	44
TOTAL	**3,984**[2]	**135**	**3,822**[2]	**80**	**3,773**[2]	**62**	**3,649**[2]	**-69**	**3,583**[2]	**-114**	**3,618**[2]	**-109**

Notes:

1. Within the information presented in WDF, it is unclear as to where the solid recovered fuel (SRF) from Mechanical-biological treatment (MBT) facilities in London is currently sent, although it is understood that some tonnage is sent to cement kilns outside London
2. The total waste managed is not the sum of its constituents within the table. Some waste going through MBT will also end up in landfill or incineration. Summing up will result in double counting of waste
3. The reject stream comprises materials rejected from MRFs and 'On-the-Go' recycling, incinerator bottom ash, and rejected material from MBT facilities. All material from these streams is assumed to be sent to landfill
4. To avoid double-counting, emissions from MBT rejects have been excluded as these are already included within the total emissions modelled from the MBT process itself
5. These reject streams are also assumed to be sent to landfill, and should be added to the figure for landfilled waste
6. It should be noted that there are some small variations in the headline results with those presented in previous reports for years 2008-12. These minor variations are the result of the need to undertake consistent historical and comparative analysis using WDF across other areas of England, as described within Appendix 1.0

Table 2-2: Performance Comparisons – 2008/9 to 2013/14

	Change in arisings 2008/9 to 2013/4	Change in emissions 2008/9 to 2013/4
Residual waste		
Landfill	- 56%	- 56%
Incineration	67%	65%
MBT	21%	21%
Organic waste		
Anaerobic Digestion	100%	100%
In-vessel Composting	8%	17%
Open Air Windrow	- 3%	
Dry Recyclables		
Paper / Card	0%	0%
Glass	- 7%	- 8%
Metals (ferrous)	- 9%	- 9%
Metals (non-ferrous)	- 7%	- 8%
Plastics	63%	-60%
Textiles	- 4%	- 4%
Wood	112%	-133%
Rejects	- 41%	- 41%
TOTAL	**- 9%**	**- 118%**

2.2 Performance of London against the EPS

The whole waste system EPS considers the CO_2 equivalent emissions *per tonne* of waste managed (CO_2e/t). As shown in Figure 2-1, London's total performance against the EPS has decreased from -0.032 to -0.030 CO_2e/t.[6] These results indicate a recent decline in performance that slows the progress towards meeting the 2015 EPS target. Figure 2-1 also shows that the rate of recycling (in tonnage terms and according to Defra's released

[6] The approach taken here differs from that of Eunomia's Recycling Carbon Index (see http://www.eunomia.co.uk/recyclingcarbonindex). At present this other index focuses solely on the carbon impacts of recycling (including organics), whereas the EPS seeks to quantify the 'whole waste system' which also includes residual treatment and transport. Boroughs can determine their performance against the EPS using the tool available from: https://www.london.gov.uk/priorities/environment/publications/the-mayors-waste-management-strategies

figures) has also decreased for the first time since performance against the EPS began to be measured, albeit only marginally (by 0.1%). As was discussed in the previous annual reports, the underlying data shows that progress against the overall EPS target up until 2012/13 was largely met through improvements in the management of residual waste. This trend is illustrated in Figure 2-2, which shows how London is performing in comparison to the targets included within the EPS for recycling, organic waste treatment and residual waste treatment respectively. The graph shows that whilst London was previously on course with regard to meeting the targets for both residual and organics treatment, it has fallen behind in its performance for recycling treatment in 2013/14. This is largely due to an increase in the overall tonnage sent to landfill increasing for the first time since the EPS began. Alongside this, the tonnage sent for incineration also increased, albeit by a much slower rate than seen in previous years.

The results for each Borough against the EPS are shown in Figure 2-3. The graph represents the elements that make up the EPS in the same manner as the graph of London performance in the main report (Figure 2-1). For the Borough model, however, results are shown for the year 2013/14 only. The lower performing Boroughs against the EPS are on the left and the better performers are on the right, with the overall London performance highlighted for comparison.

The results show that some Boroughs, such as Ealing, Merton and Richmond – all of which perform better than London's average performance for recycling – perform less well against the overall EPS score as most of their residual waste is sent to landfill, reducing their overall EPS performance. Other Boroughs such as Wandsworth with a relatively low recycling rate perform better in the EPS as less waste is sent to landfill.

Figure 2-4 shows the recycling performance for 'inner' and 'outer' London Boroughs.[7] Here the pattern is very clear, with very few exceptions (one of which is the City of London) the outer Boroughs perform well, whilst the inner Boroughs are clustered towards the bottom of the chart.

The substantial fall in paper arisings in recent years continues to impact on recycling levels, and this continues to contribute to London's relatively poor performance in respect of meeting the EPS target as was discussed in last year's EPS report. This is discussed further in Appendix 2, which also provides further background information in respect of the waste industry that is potentially relevant when considering the performance of the boroughs against the EPS. Appendix 3, as mentioned above, presents a more detailed analysis of London's performance on a Borough level in order to explore the factors affecting performance in more detail.

[7] http://www.londoncouncils.gov.uk/londonfacts/londonlocalgovernment/londonboroughs.htm

Figure 2-1: London's Performance against the EPS (2008-2014)

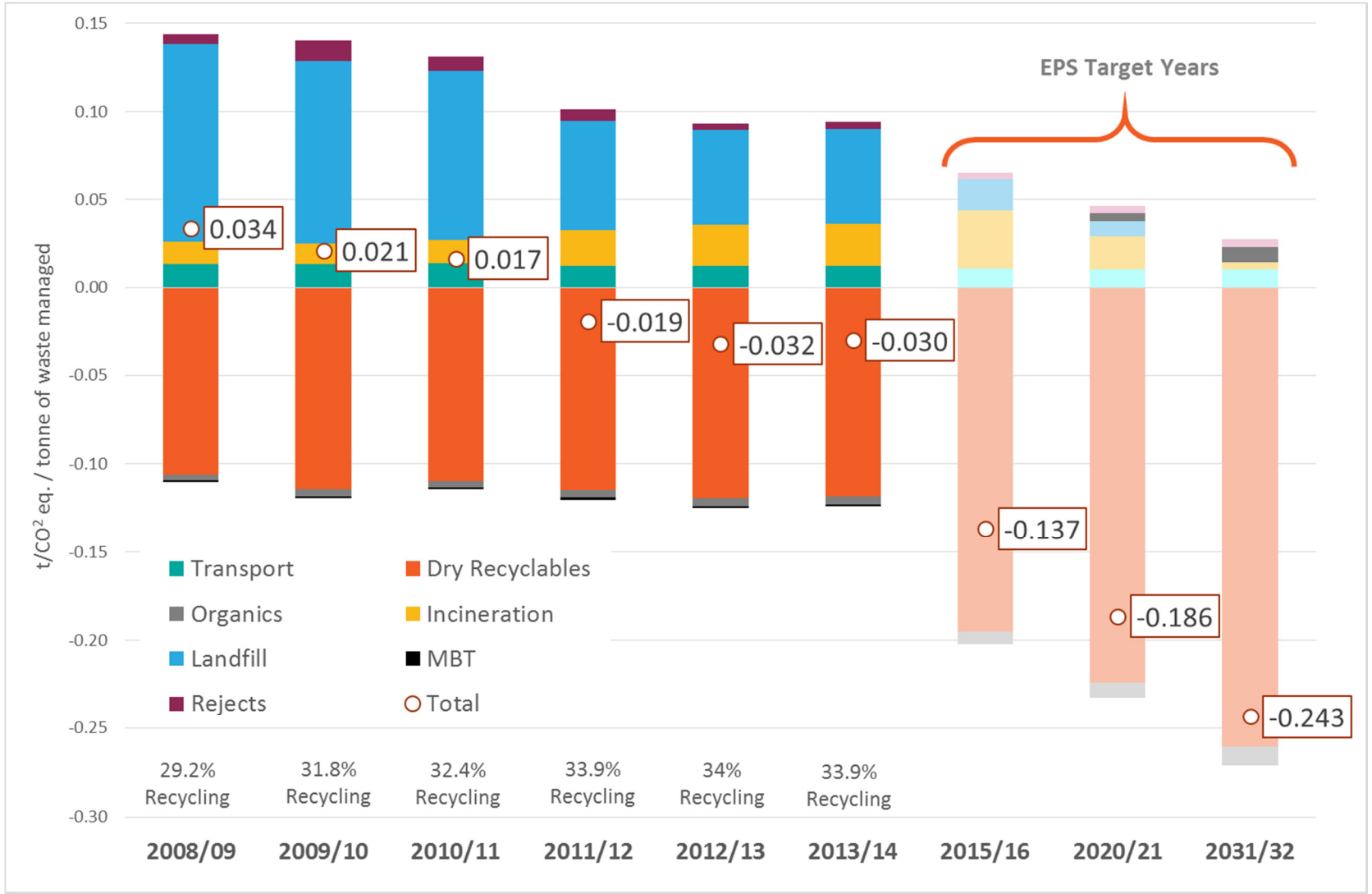


Figure 2-2: Breakdown of Historic and Future Performance against London's EPS Targets

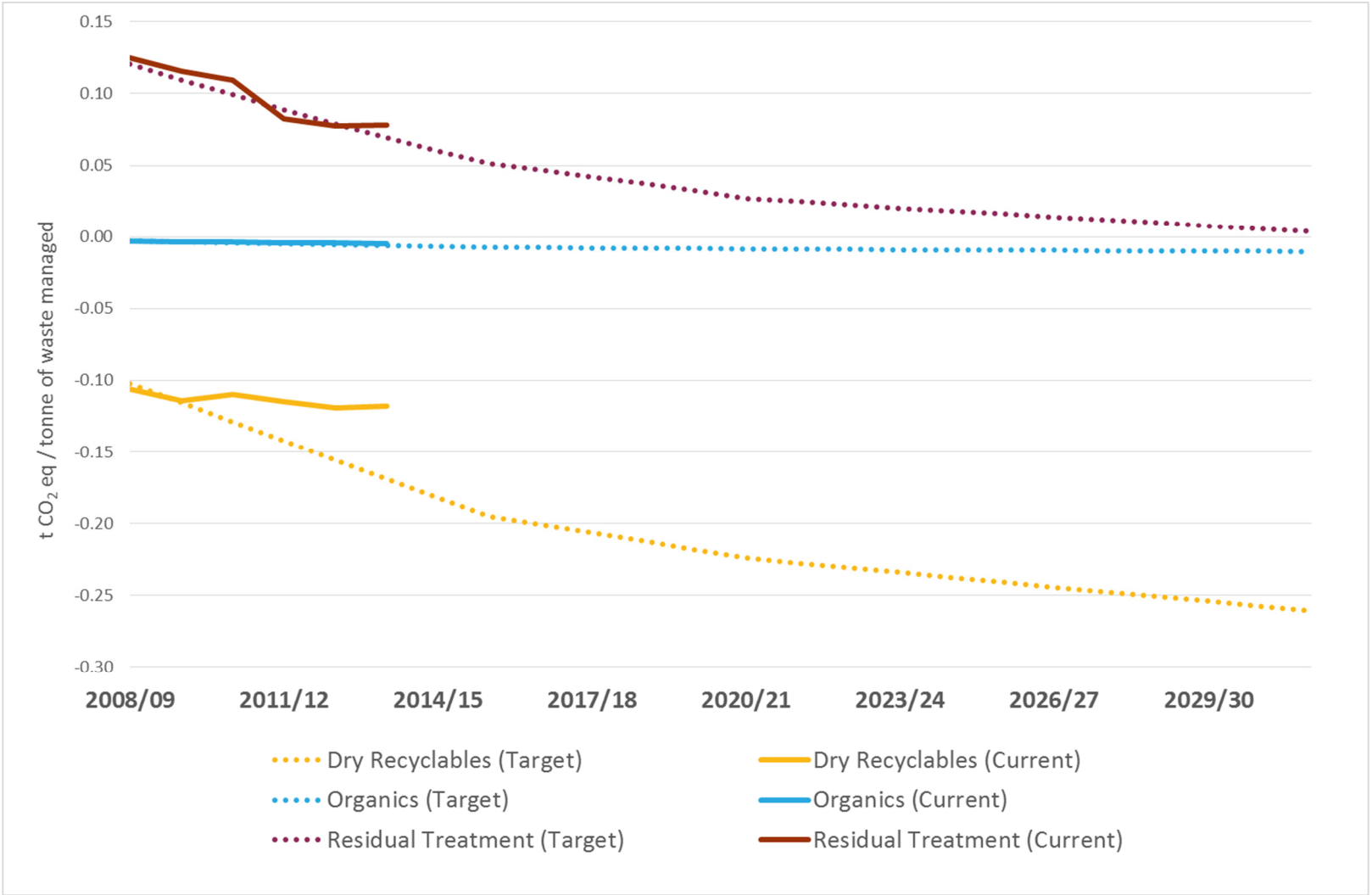


Figure 2-3: Performance against the EPS of London Boroughs for 2013/14

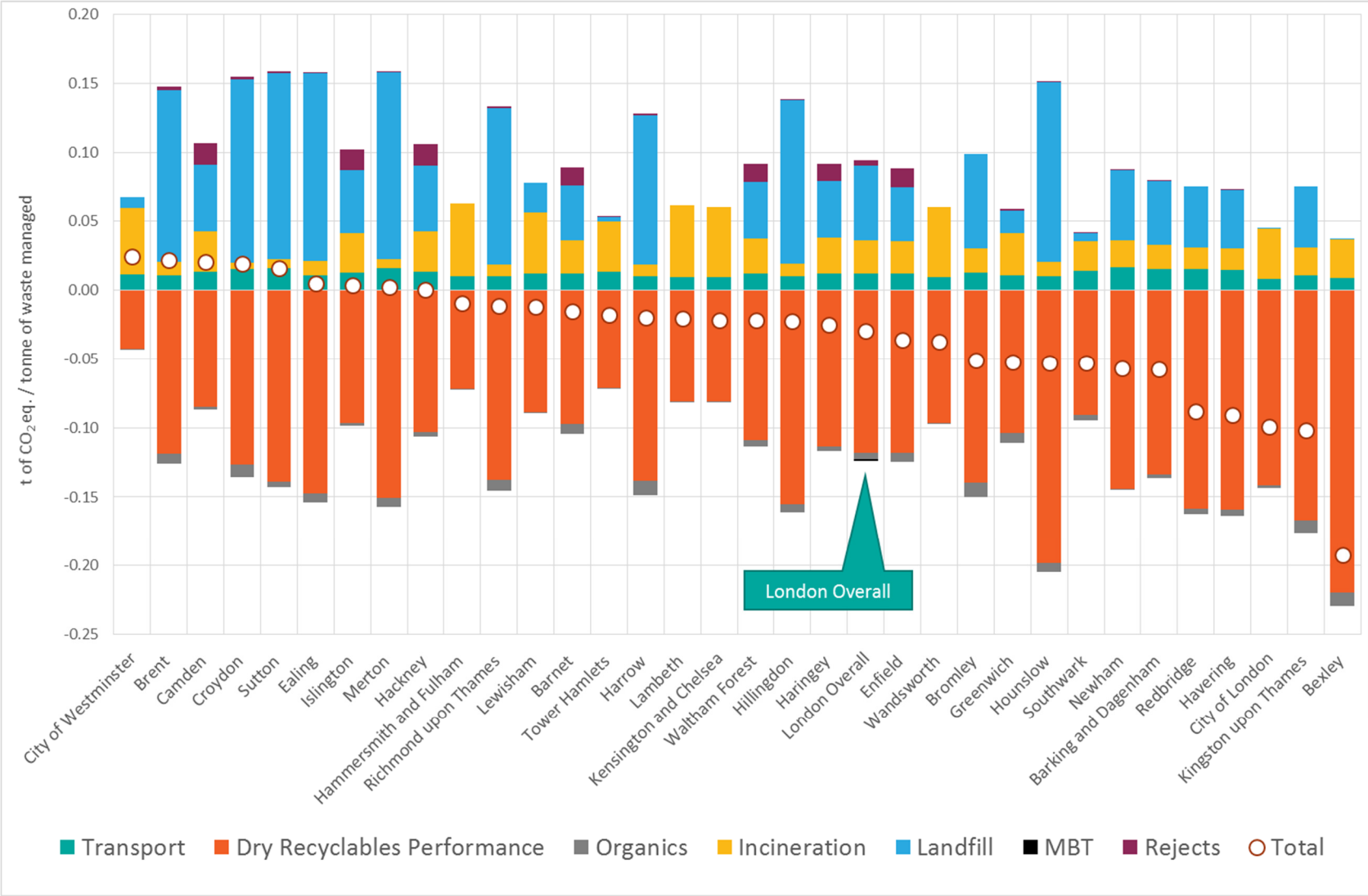
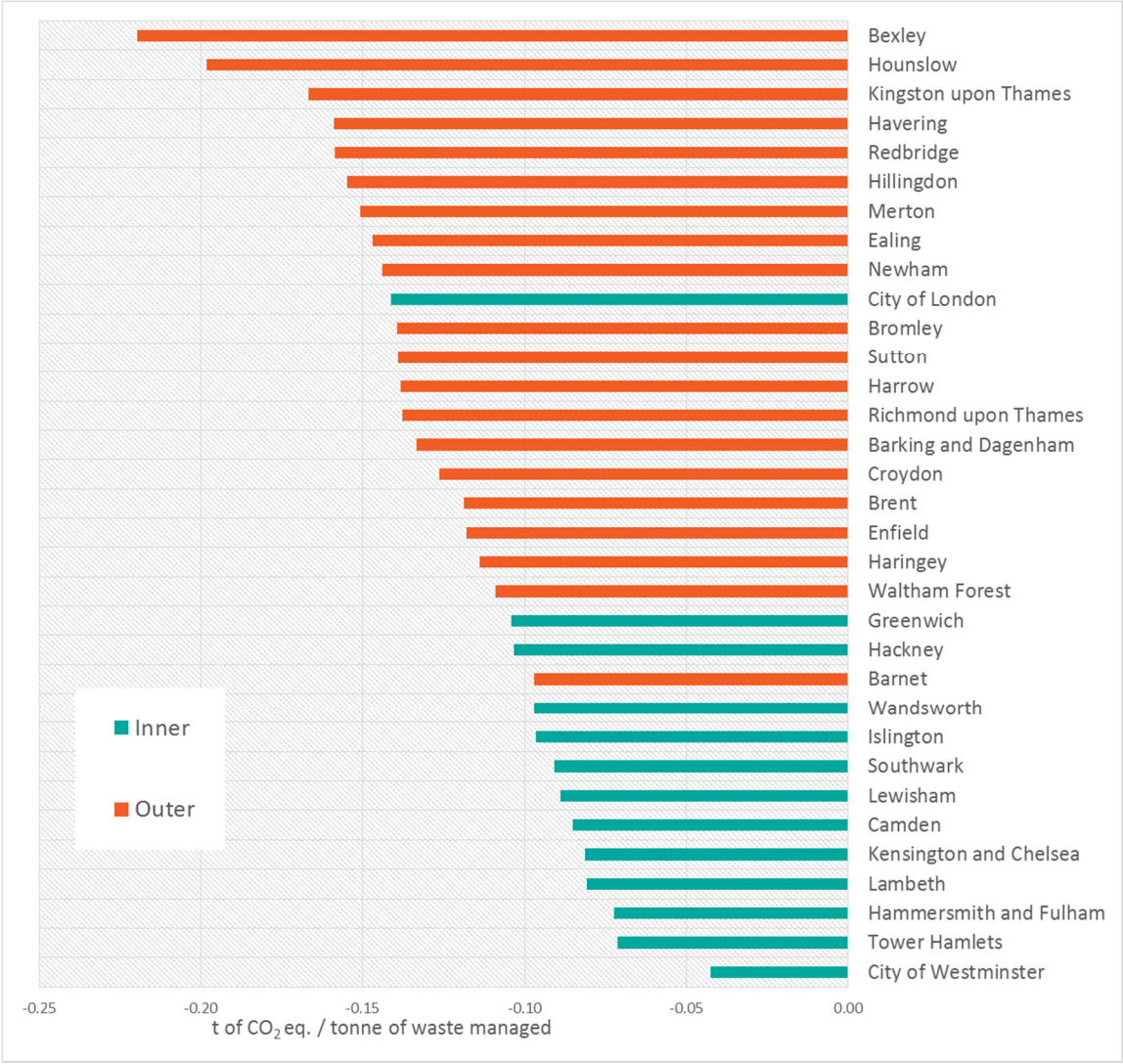


Figure 2-4: Recycling Performance of Inner and Outer London Boroughs



APPENDICES

A.1.0 Appendix 1 - Performance of Other City Areas

The EPS report published for 2012/13 included analysis of the performance of two other city regions, the West Midlands and Greater Manchester. Updated graphs for these two areas are presented in Figure A. 1 Figure A. 1: Performance of the West Midlands (2008-2014)and Figure A. 2 respectively. These results show that – as is the case for London - performance has deteriorated for the West Midlands over the period 2013/14 in comparison to the previous year. However, the performance of Greater Manchester against the EPS has improved since last year, by virtue of a further decrease in the amount of waste being sent to landfill together with a further increase in recycling. Although Greater Manchester's recycling rate now exceeds the 45% recycling rate target set within the EPS for London of 2015/6, the city has not yet achieved the EPS target for that year. This is because the performance in tonnage-based terms has been considerably influenced through higher capture of source segregated organic materials for composting which yield only modest carbon savings – confirming the importance in the EPS of recycling the right kind of materials, i.e., those (such as metals, plastics and textiles) that yield the higher carbon savings when recycled.

Figure A. 1: Performance of the West Midlands (2008-2014)

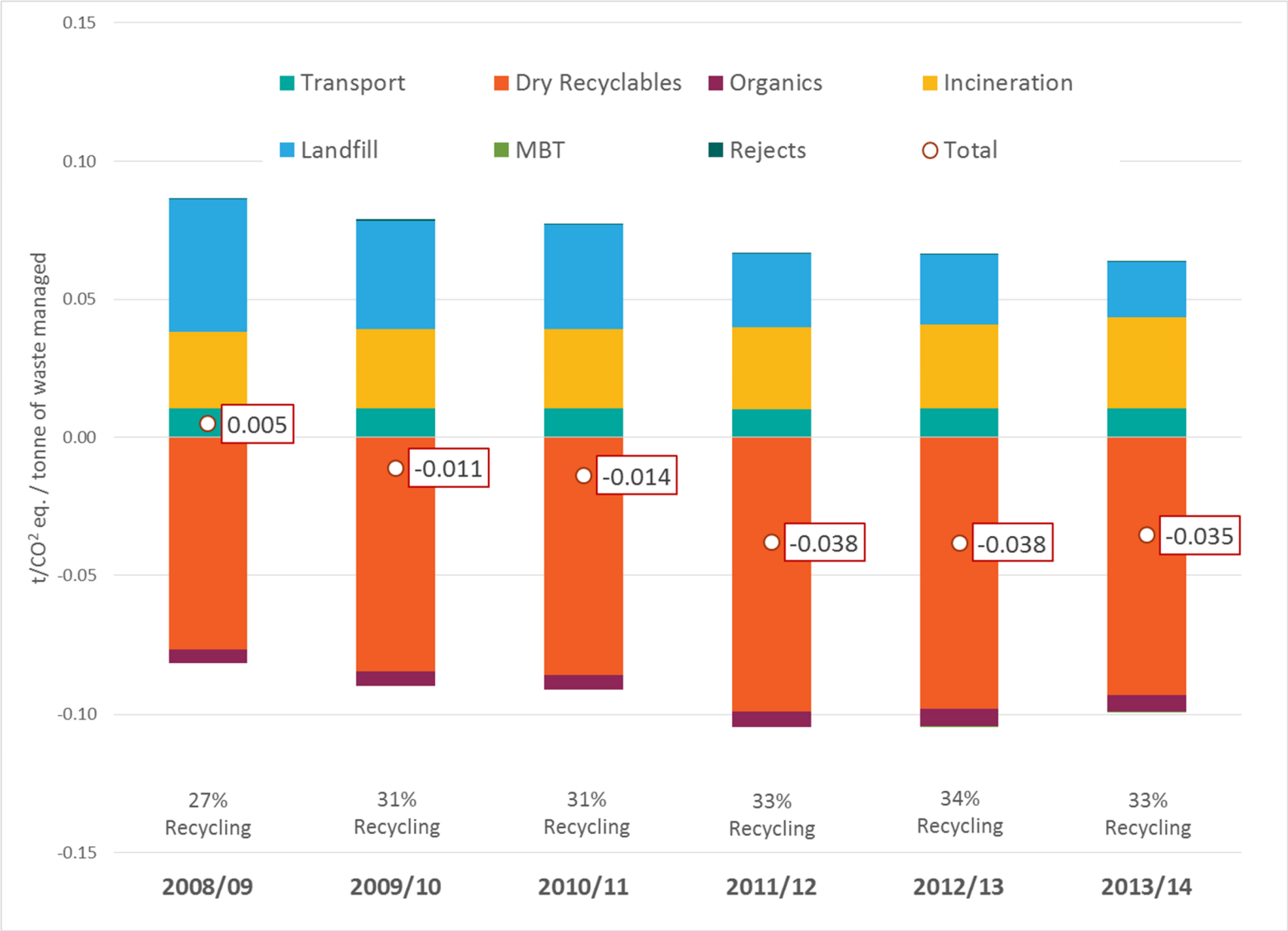
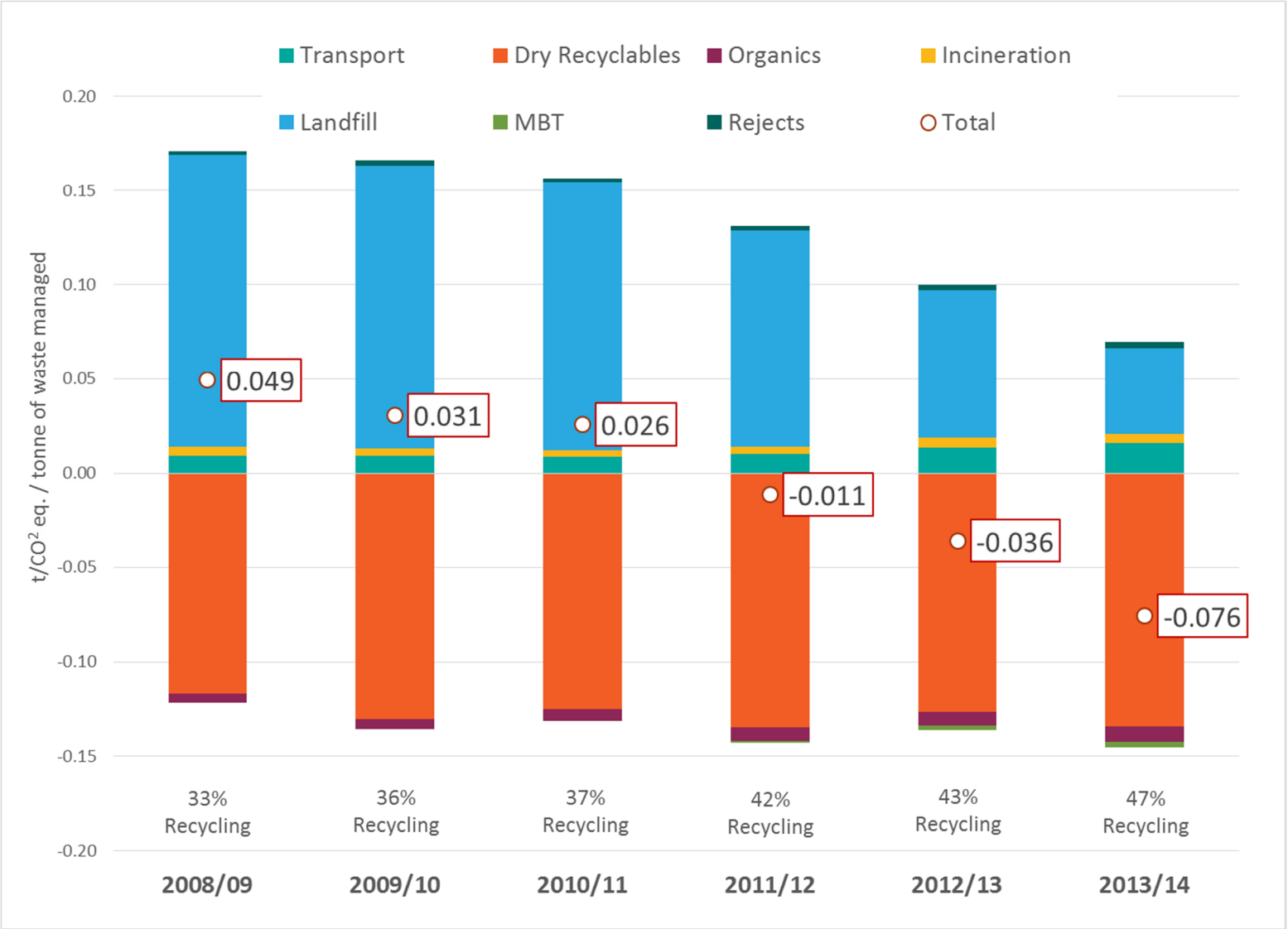


Figure A. 2: Performance of Greater Manchester (2008-2014)



A.2.0 Appendix 2 – Factors Potentially Affecting EPS Performance

The previous report on performance for 2012/13 acknowledged that a number of factors may have affected the performance of local authority recycling collections in recent years. Sections A.2.1 to A.2.3 provide an update on the situation for each of these factors. Subsequently, Section A.2.4 considers the impact of the introduction of the Waste England and Wales Regulations 2011.

A.2.1 Reduction in Paper Arisings

The previous report confirmed there has been a substantial decline in the sales of newspapers and magazines over the period since the EPS targets were initially set. As there has been no update on the national composition data it is not possible to tell whether the past year has seen a continuation of the trend for reduced paper waste generation across the whole waste stream.

Whereas the amount of separately collected paper increased steadily over the previous three year period, this year's EPS results show a 4% drop in the amount of paper collected for recycling of 14 thousand tonnes from the previous year, such that the amount of paper recycled has now fallen to the level seen in the first year that results for the EPS were developed (2008/9). As was discussed in the EPS update report for 2012/13, a decline in paper recycling has a relatively significant impact on the EPS results, given the relatively large contribution this material makes to the total recycling tonnage. In the absence of updated composition data it is not possible to tell whether the reduced amounts are indicative of a further decline in paper arisings, or whether the reduction in volumes is as a consequence of poorer collection system performance.

A.2.2 Operation Green Fence

Operation Green Fence was in place from April till November 2013. The policy was aimed at reducing the amount of poor quality waste entering Chinese ports from overseas. A wide range of recyclate streams was targeted, including paper and plastics as well as WEEE streams. During this period, Chinese port officials enforced legislation relating to the holding of import licenses at Chinese ports. Loads from European and America were targeted; the policy led to some loads being rejected, and an overall reduction in the amount of waste imported for reprocessing into the country.

During the initial operation of the Fence there was a decrease in the amount of plastic exported, but amounts recovered as the markets reacted to the enforcement of the legislation.[8] Following the end of the Green Fence it is unclear whether there has been any lasting change with respect to the quality of the streams imported from Europe and elsewhere, with some authors suggesting that those exporting have largely returned to the same behaviours occurring prior to the policy being enacted.[9] It is therefore unclear to what extent the policy has impacted on the performance of London boroughs against the EPS in recent years.

A.2.3 Commodity Prices

Data published by LetsRecycle.com suggests a mixed picture for commodity prices over the past year:[10]

- Whilst there was a decline in the prices for clear PET, an increase was seen over the same period for natural HDPE, reflecting the continued demand for this type of material. Prices for the other polymers have largely stayed the same. Prices remain relatively low corresponding to the relatively low crude oil prices with which these prices are linked;
- All glass prices have fallen sharply throughout the year; prices for mixed glass are now less than £0 per tonne and those for green less than £10 per tonne.[11] Prices for this material have fallen following the change by Defra of the UK's glass packaging recycling target (which, in turn, occurred following a revision of the amount of glass packaging placed on the market);[12]
- All ferrous metal prices have fallen over the course of the year. Prices for non-ferrous metal grades have seen less of an increase than previously; prices for the higher grades dropped somewhat during the first part of the year but then recovered, whilst the price for the lower grades remained relatively constant;
- There has been a slight drop in the price for textiles, with the biggest decline seen in the value of material collected through shop collections (the middle grade stream);
- For paper the picture is mixed. Whilst there has been a slight decline in price of the lower grades, the higher grades have seen a small increase in price. The prices for the lower grades fell during the first part of the financial year in part due to increasing quality standards being imposed on material being exported to

[8] Velis C A (2014) Global Recycling Markets: Plastic Waste – a story for one player – China; A Report from the ISWA Task Force on Globalisation and Waste Management, September 2014
[9] See http://resource.co/magazine/article/no-time-waste
[10] See http://www.letsrecycle.com/prices/
[11] Where prices are less than zero, this may mean a payment must be made before material will be collected
[12] See http://www.letsrecycle.com/prices/glass/

China.[13] However, prices have since recovered somewhat, particularly for newspapers and magazines.

The above suggests a decline in the value for many materials, with notable exceptions being high grade paper and natural HDPE. Prices have remained reasonably constant for a limited number of materials, including non-ferrous metals. The extent to which the reduction in value can be expected to impact upon collection costs will depend on the nature of the collection contracts being operated by the London authorities; some will have been insulated from the changes through long term fixed contracts, whilst in other cases the fall in value will directly affect council finances. Data on this is not publicly available, and as such it is not clear to what extent the change in prices has impacted on the performance of boroughs against the EPS.

A.2.4 The Waste England and Wales Regulations 2011

The Waste England and Wales Regulations 2011 introduced two requirements on local authorities with regard to the operation of their collection systems:[14] [15]

- Regulation 12, which came into force in 2011, places an ongoing requirement on authorities to apply the waste hierarchy; and
- Regulation 13 states that from 1st January 2015, all waste collectors in England and Wales will be required to collect glass, metal, paper, and plastic ('the four materials') in separate streams where doing so is both necessary and technically, economically and environmentally practicable (TEEP).

Effectively, 'necessity' and 'practicability' are two tests that, if met, mean that separate collection is required. There is no statutory guidance on how to determine whether separate collection is 'necessary' or 'practicable'. However, in the spring of 2014 WRAP, LWARB and Waste Network Chairs commissioned a 'Route-map' to assist authorities in interpreting the law.[16] The Environment Agency has since signalled that it will take account of the Route-map as part of its regulatory approach.[17]

At present, a good deal remains uncertain regarding how the Waste Regulations will be enforced. The Environment Agency (EA) has begun to outline its approach to enforcement, but has not yet indicated how active it proposes to be in its role as the enforcement body for this legislation; nor have any third parties disclosed an intention to seek to clarify the requirements of the law by pursuing legal action against authorities.

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[13] See http://www.letsrecycle.com/news/latest-news/recyclers-commodities-price-warning/
[14] UK Government (2011) *The Waste (England and Wales) Regulations 2011*, 28th March 2011
[15] UK Government (2014) *The Waste (England and Wales) (Amendment) Regulations 2012*, 1st October 2012
[16] WRAP, LWARB and Waste Network Chairs (2014) *Waste Regulations Route-map*, April 2014
[17] Environment Agency (2014) *Separate Collection of Recyclables: Briefing Note*, June 2014

As a result, there is a risk that some authorities may act in anticipation of enforcement action that may not, in practice, be forthcoming; there is also a risk that some authorities may do too little, and find themselves subject to attention from either the EA or third parties that results in them needing to make changes. For authorities that have followed the Waste Regulations Route-map process and acted on the findings, the likelihood of these risks emerging is in all probability low, although the impact of enforcement, and the need to make change in some haste, may be high.

The uncertainty over the detail and enforcement of the Regulations is such that it is unlikely that these will have had a major impact on the performance of London's recycling collections to date. However, there may be some impact on performance in the future as the full impact of the legislation is felt.

The legislation may result in two possible outcomes of potential relevance to the EPS:

- There may be a shift from kerbside sort to commingled systems;
- Those operating commingled systems may be forced to take action to improve the performance of those systems with regard to the proportion of contaminants within the mixed material streams, in order to ensure that these systems are compliant with the regulations.

The impact of these outcomes on the actual results of the EPS is uncertain. Results presented in Section A.3.3.1 suggest there is no obvious pattern between good performance and the type of collection system operated by the local authority. As such it is unclear whether there would be much improvement in EPS performance resulting from a shift in collection from a kerbside sort system to a commingled system.

Clearly, an environmental benefit should result from an improvement in the quality of the material collected. However, it is not clear to what extent contamination is taken into account at present in the waste collection data inputted into WDF. As such, the WDF data may mask to a certain extent any actual improvement in performance in future years that occurs through the Waste England and Wales Regulations.

Nonetheless, it will be interesting to examine the performance of local authority collections in London over the next few years as the full impact of the legislation is seen. These changes can be expected to occur against a backdrop of a reduction in council finances.

A.2.5 Summary

The above assessment suggests that the last year has seen - for the most part – relatively little major change in respect of the factors considered potentially impactful with regard to London's performance against the EPS. The substantial fall in paper arisings continues to impact on recycling levels, and this continues to contribute to London's relatively poor performance in respect of meeting the EPS target as was discussed in last year's EPS report. Commodity prices for the most part either declined slightly or stayed static, but again, there was no significant shift. It is too early yet to see the influence of the

introduction of the Waste England and Wales Regulations 2011; the potential influence here may be masked by limitations in the data from Waste Data Flow.

A.3.0 Appendix 3 – Performance of Individual London Boroughs against the EPS

In order to better understand London's performance, in this Section we have assessed the performance of each individual borough against the EPS target.

A.3.1 Methodology

Much of the underlying information required to model the performance of the Boroughs against the EPS is taken from the 2013/14 WDF, including:

- The tonnage of materials recycled;
- The tonnage of residual waste treated (including the type of treatment used, i.e., landfill, incineration, MBT); and
- The tonnage of food and green wastes treated via composting and AD.

The model for the performance of the Boroughs uses the same approach to assessing performance as is used to consider the performance of the whole of London. Thus assumptions on the performance of the residual waste treatment technologies, the split of ferrous and non-ferrous metals (where mixed metals fractions are collected) and the proportion of glass re-processed into containers have been retained from those originally used to develop London's EPS.[18]

WDF contains details of the transport of residual waste including the end destination and mode of transport used to transport this waste. Other transport assumptions (including those for waste collection impacts) are also retained from the EPS model for the whole of London. The EPS excludes, however, the impact of the onward transport of recyclable materials due to the considerable uncertainties associated with modelling this impact, resulting from the multitude of potential end-destinations (both domestic and overseas) for materials reprocessing.[19]

Although London is split into Boroughs geographically, it is also split into four joint waste disposal authorities (WDAs) —North London, East London, West London and Western Riverside— which are made up of individual boroughs that only deal with waste

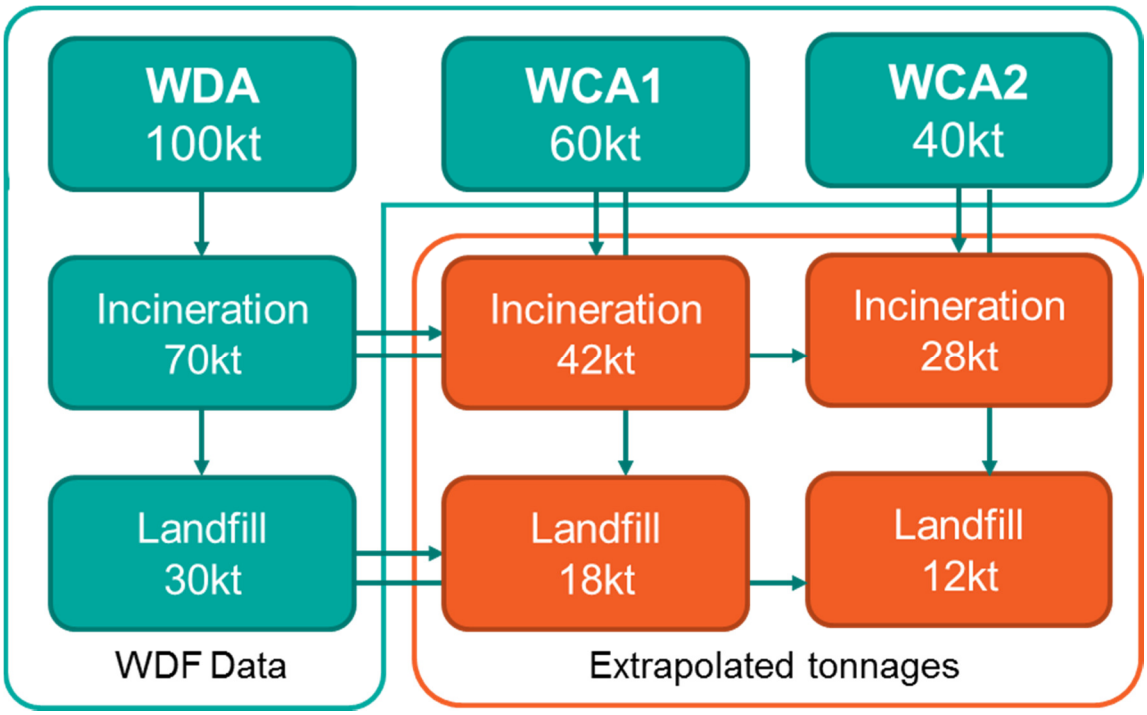
[18] Eunomia Research & Consulting (2010) *Development of a Greenhouse Gas Emissions Performance Standard for London's Municipal Waste*, Report for the Greater London Authority, August 2010

[19] Our experience has shown that these emissions are usually relatively insignificant in comparison to the impacts associated with waste treatment and recycling.

collection.[20] There are also a number of individual boroughs acting as unitary authorities that deal with both collection and disposal of waste.

WDF shows the residual waste disposal tonnages for each Borough, but it does not indicate which treatment method is used for the residual waste. This information is only given at the level of the waste disposal and unitary authorities. It has therefore been necessary to extrapolate from the available data in WDF so that the residual waste is assigned to each waste disposal authority. Figure A. 3 presents an example of the method that has been undertaken to achieve this. The process relies upon the assumption that the proportion of waste sent to incineration is consistent for all waste collection authority (WCA) that forms each WDA (70% is assumed). The same method is used to assign the transport impacts of the residual tonnages to each borough. Recycling tonnages by material are reported for each Borough, however, so no extrapolation is necessary in this case. This method allows all of the boroughs to be compared on an equal footing without double counting any of the arisings.

Figure A. 3: Example of Method of Extrapolation of Residual Treatment Routes



[20] In addition, South London Waste Partnership, is a similar group comprising four local authorities

A.3.2 Performance against the EPS of London Boroughs for 2013/14

The results for each Borough against the EPS are shown in Figure A. 4. The graph represents the elements that make up the EPS in the same manner as the graph of London performance in the main report (Figure 2-1). For the Borough model, however, results are shown for the year 2013/14 only. The lower performing Boroughs against the EPS are on the left and the better performers are on the right, with the overall London performance highlighted for comparison.

The results suggest that the better performing Boroughs tend to be those that manage both recycling and residual waste relatively well. Some Boroughs, such as Ealing, Merton and Richmond – all of which perform better than London's average performance for recycling – perform less well against the overall EPS score as most of their residual waste is sent to landfill, reducing their overall performance. Other Boroughs such as Wandsworth with a relatively low recycling rate perform better in the EPS as less waste is sent to landfill.

In addition, some boroughs with a relatively low (tonnage based) recycling rate also perform better than others by targeting more of the materials with a higher embodied carbon. This can be seen in Table A. 1, which provides a breakdown of the dry recycling performance using the EPS score for each borough by material, alongside the tonnage based recycling rate (here the boroughs are presented in the table in the order of the performance in respect of the EPS scores for recycling). The table confirms, for example, that boroughs such as Merton and Redbridge perform relatively well in respect of the EPS carbon-based dry recycling performance despite having a lower recycling rate, as they collect a greater quantity of metals than some of the other boroughs.

A.3.3 Recycling Performance and Characteristics of London Boroughs for 2013/14

Further analysis has been undertaken to establish the characteristics of the Boroughs that perform well against the EPS. The following factors have been considered for each Borough:

- Kerbside collection type (i.e., kerbside sort or commingled) and frequency; and
- Borough classification (i.e., inner or outer London)

The analysis then considers the relative performance of the Boroughs with reference to key socio-demographic indicators relating such as those relating to housing and the proportion of residents within certain age groups. The data on socio-demographic

characteristics have been gained from the Office for National Statistics (ONS) based upon the outturns of the 2011 UK census.[21] A number of categories have been considered:

- The proportion of properties in the borough that are flats;
- Proportion of rented properties; and
- Population density.

Data on the City of London is not provided for most of the above categories and as such results are not presented for this area. It is also noted that the City of London is not technically a Borough.[22] The population size is very small (at only 7,000) making it more difficult to draw parallels between recycling and demographics; in addition, collection systems are very different to the surrounding areas (waste collection occurs every working day). We note that other similar analyses, such as the ONS Area Classification, incorporate the City of Westminster and the City of London into one category as they share similar attributes, and we have therefore taken a similar approach here.

Although the EPS considers performance of both residual waste and recycling, the dry recycling performance element of the EPS is used as the sole comparator in this analysis, as this is the element that is most influenced by the characteristics (both physical and social) of each borough - residual performance being largely dictated by higher level policy and disposal decisions enacted by the Borough or WDA.

[21] http://data.london.gov.uk/census/data/
[22] http://www.londoncouncils.gov.uk/londonfacts/londonlocalgovernment/londonboroughs.htm

Figure A. 4: Performance against the EPS of London Boroughs for 2013/14

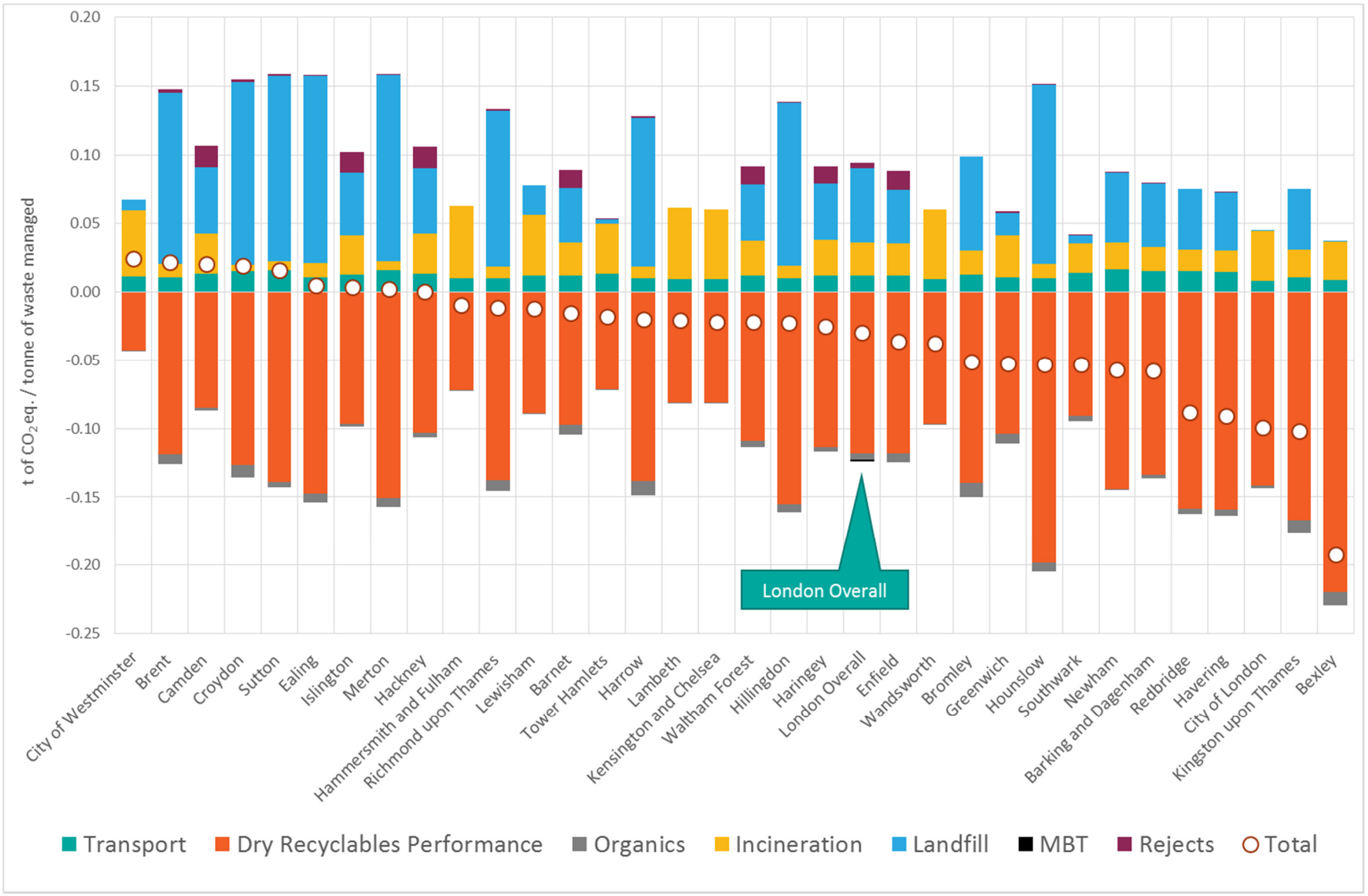


Table A. 1: EPS Recycling Dry Recycling Performance for 2013/14 in Order of low to high score (ktCO2e)

Borough	Contribution to the EPS score by each material (ktCO2e)							DEFRA (N192) Recycling Rate
	Paper / Card	Glass	Ferrous Metals	Non-Ferrous Metals	Plastics	Textiles	Total EPS score for dry recycling	
City of Westminster	-0.022	-0.004	-0.002	-0.006	-0.008	0.000	**-0.043**	21%
Tower Hamlets	-0.020	-0.002	-0.007	-0.019	-0.019	-0.004	**-0.071**	28%
Hammersmith and Fulham	-0.027	-0.004	-0.005	-0.015	-0.015	-0.006	**-0.072**	21%
Lambeth	-0.025	-0.004	-0.008	-0.022	-0.015	-0.007	**-0.081**	21%
Kensington and Chelsea	-0.038	-0.004	-0.005	-0.014	-0.014	-0.006	**-0.081**	25%
Camden	-0.031	-0.003	-0.007	-0.020	-0.017	-0.007	**-0.085**	29%
Lewisham	-0.023	-0.002	-0.006	-0.017	-0.019	-0.023	**-0.089**	18%
Southwark	-0.028	-0.003	-0.010	-0.033	-0.017	0.000	**-0.091**	34%
Islington	-0.032	-0.003	-0.009	-0.025	-0.018	-0.011	**-0.097**	33%
Wandsworth	-0.032	-0.005	-0.006	-0.023	-0.016	-0.013	**-0.097**	20%
Barnet	-0.028	-0.003	-0.010	-0.030	-0.015	-0.011	**-0.097**	36%
Hackney	-0.029	-0.003	-0.006	-0.040	-0.015	-0.010	**-0.103**	25%
Greenwich	-0.032	-0.004	-0.013	-0.027	-0.018	-0.010	**-0.104**	39%
Waltham Forest	-0.035	-0.003	-0.011	-0.031	-0.020	-0.009	**-0.109**	33%
Haringey	-0.040	-0.003	-0.011	-0.031	-0.023	-0.005	**-0.114**	36%
Enfield	-0.037	-0.003	-0.011	-0.031	-0.030	-0.006	**-0.118**	39%
London Overall	**-0.030**	**-0.003**	**-0.014**	**-0.041**	**-0.019**	**-0.013**	**-0.121**	34%
Brent	-0.038	-0.003	-0.010	-0.028	-0.017	-0.023	**-0.119**	41%
Croydon	-0.028	-0.003	-0.014	-0.041	-0.022	-0.019	**-0.126**	42%
Barking and Dagenham	-0.019	-0.001	-0.027	-0.078	-0.008	0.000	**-0.134**	25%
Richmond upon Thames	-0.041	-0.005	-0.018	-0.044	-0.031	0.000	**-0.138**	43%
Harrow	-0.036	-0.003	-0.014	-0.041	-0.030	-0.014	**-0.138**	49%

Borough	Contribution to the EPS score by each material (ktCO2e)							DEFRA (N192) Recycling Rate
	Paper / Card	Glass	Ferrous Metals	Non-Ferrous Metals	Plastics	Textiles	Total EPS score for dry recycling	
Sutton	-0.039	-0.003	-0.016	-0.041	-0.029	-0.011	**-0.139**	37%
Bromley	-0.031	-0.005	-0.021	-0.059	-0.014	-0.010	**-0.139**	50%
City of London	-0.063	-0.006	-0.012	-0.023	-0.022	-0.016	**-0.141**	39%
Newham	-0.021	-0.001	-0.030	-0.085	-0.007	0.000	**-0.144**	18%
Ealing	-0.023	-0.004	-0.016	-0.044	-0.023	-0.038	**-0.147**	40%
Merton	-0.038	-0.003	-0.015	-0.040	-0.030	-0.024	**-0.151**	39%
Hillingdon	-0.038	-0.003	-0.017	-0.052	-0.022	-0.024	**-0.155**	43%
Redbridge	-0.020	-0.004	-0.030	-0.086	-0.019	0.000	**-0.159**	29%
Havering	-0.028	-0.002	-0.030	-0.086	-0.012	-0.002	**-0.159**	32%
Kingston upon Thames	-0.037	-0.005	-0.018	-0.052	-0.031	-0.024	**-0.167**	46%
Hounslow	-0.023	-0.003	-0.026	-0.078	-0.026	-0.042	**-0.198**	35%
Bexley	-0.031	-0.004	-0.030	-0.086	-0.022	-0.046	**-0.220**	55%

Notes:

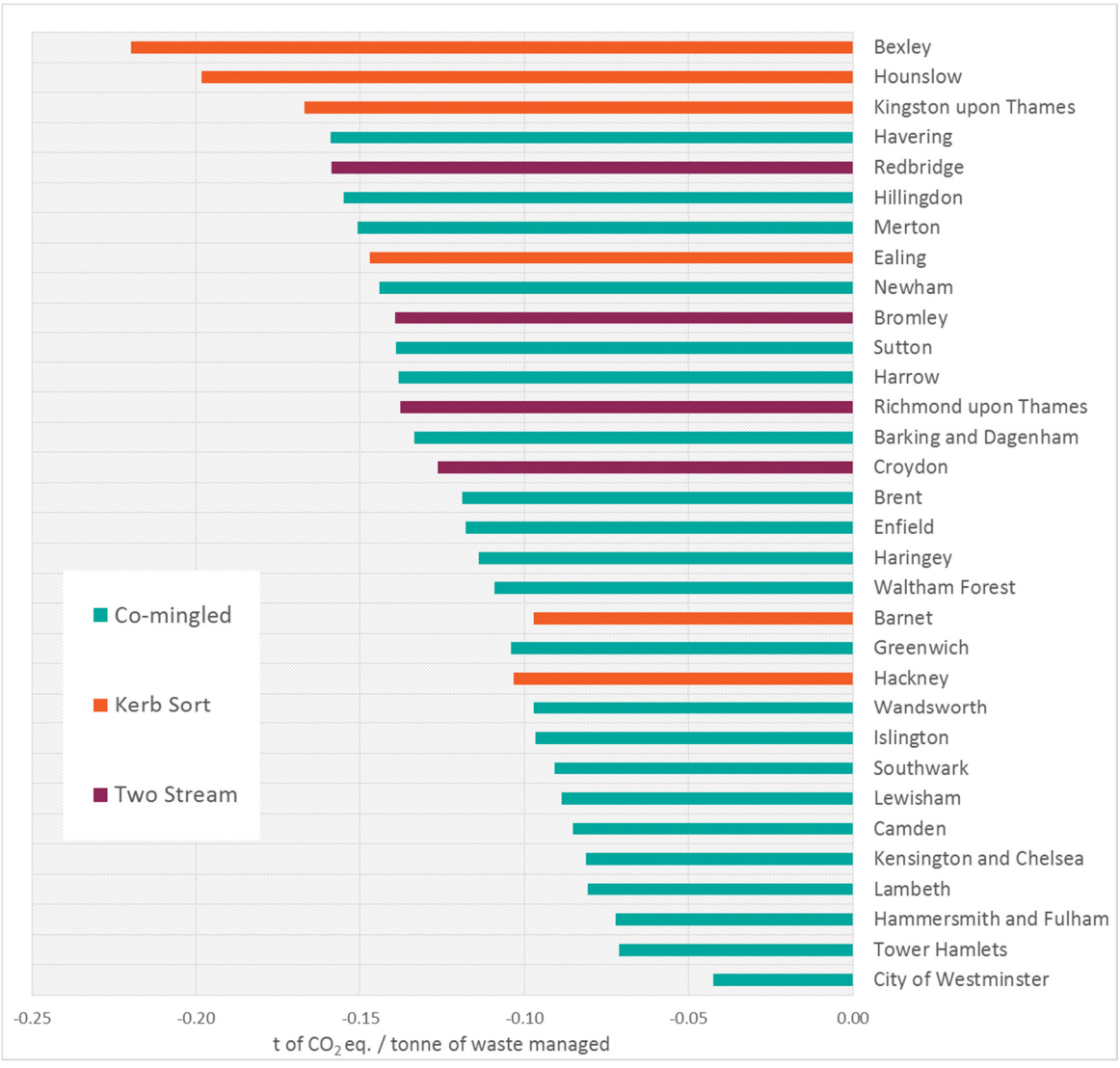
The NI192 recycling rate includes material collected for composting as well as that sent for dry recycling.

A.3.3.1 Kerbside Collection Type and Frequency

Figure A. 5 shows the recycling performance for each Borough as measured by the EPS, with the performance bar being coloured-coded to show the type of recycling collection that is in place. All results are 'negative', indicating a reduction in GHG emissions: the larger the bar, the better the Borough's performance.

The graph shows that the majority of London Boroughs operate co-mingled collections, albeit the top three performers in the capital all operate kerbside sort systems. However, there are low and high performers using co-mingled and kerbside sort collections suggesting it is possible to perform well regardless of the collection system.

Figure A. 5 – Recycling Performance by Kerbside Collection Type



Similarly, it was also found that collection frequency did not have a large influence on the performance of the recycling collection service. Most London Boroughs operate a

weekly collection service for recycling, but the seven that collect fortnightly are all mid-level performers.

A.3.3.2 Proportion of Flats

Figure A. 6 shows the recycling performance element of the EPS for each Borough (on the left hand axis and represented by the bars of the chart), along with the proportion of households served by kerbside collection that are flats (on the right hand axis and reflected in the dots on the chart).

The chart also includes a dotted line illustrating the correlation between the two variables. The statistical analysis which underlies the development of this line suggests there is a strong correlation between the proportion of flats and recycling performance under the EPS, as evidenced by the relatively high R^2 value shown on the dotted line.[23]

There is now a considerable body of evidence with regard to the influence of socio-demographic factors on the performance of household recycling schemes. The more recent evidence (from 2008 to the present day) was synthesised in a report published by WRAP in 2014.[24] This led on from earlier work undertaken by Resource Futures for WRAP which considered the characteristics of the better performing recycling collection systems.[25]

The report by WRAP confirms that although the term 'flats' covers a massive variation in physical and social settings, these properties are nonetheless often associated with poor recycling performance, with low materials capture and (sometimes) high contamination of the collected streams. The poor performance is, in some cases, partly influenced by the type of collection systems offered to residents in this type of dwelling: communal bins are widely used, making it more difficult and time-consuming to recycle, and much easier to take the residual disposal route. Space for the storage of recycling materials may also be more limited within the property than for other types of property.

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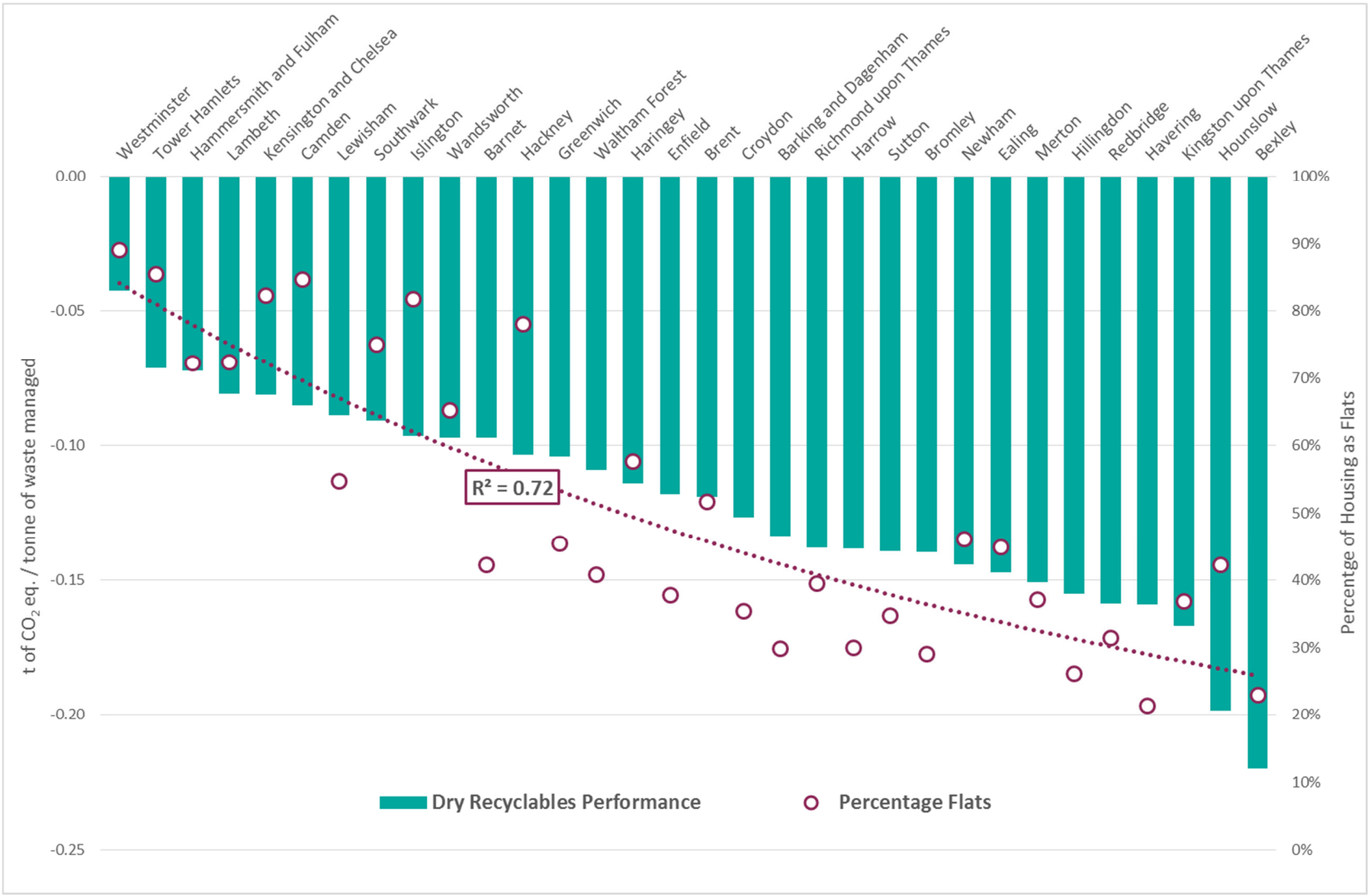
[23] The strength of the correlation is indicated by an 'R^2' value. The R^2 value is a fraction between 0.0 and 1.0. When R^2 equals 0.0, the best-fit curve fits the data no better than a horizontal line going through the mean of all Y values. When R^2 equals 1.0, all points lie exactly on the curve with no scatter. Higher values generally indicate that the model fits the data better, although there are no definitive guidelines with regard to what values of R^2 are high, adequate or low

[24] M.E.L Research (2014) *Barriers to recycling: A review of evidence since 2008*, Report for WRAP, December 2014

[25] Resource Futures (2010) *Analysis of Kerbside Dry Recycling Performance in the UK 2008/09*, Report for the Waste & Resources Action Programme, September 2010, ‧www.wrap.org.uk/local_authorities/research_guidance/collections_recycling/benchmarking.html‧

Figure A. 6: Percentage of Households that are Flats against Recycling Performance



In addition, there is also an inter-correlation between the property type and the associated lifestyle and circumstances of flat dwellers. Transience, high social mobility, social disengagement and busy lifestyles are identified as common features of flat dwellers as well as being barriers to recycling. The influence of these factors is discussed further below.

A.3.3.3 Population Density

Population density is influenced to a certain extent by dwelling type and as such it is to be expected that there will also be a link between the results shown in Figure A. 6 and those presented in this section. Figure A. 7 shows the recycling performance element of the EPS for each Borough (on the left hand axis and represented by the bars of the chart), along with population density (on the right hand axis and reflected in the dots on the chart). This shows that there is a relationship between the two variables, which is slightly less strong than that between performance against the EPS and dwelling type.

A.3.3.4 Proportion of Rented Properties

Taking a similar approach to that in Section A.3.3.2 which considers the proportion of dwellings served by collection services that are flats, Figure A. 8 presents the results showing the type of tenure (on the right hand axis and reflected in the dots on the chart) against the recycling performance element of the EPS for each Borough (on the left hand axis and represented by the bars of the chart). The graph shows the highest proportion of rental properties is in Tower Hamlets (with 75% of properties being rented) whilst the lowest proportion is in Havering at 25%, and these two extremes also appear at opposing ends of the spectrum of performance with regard to recycling.

The correlation between these two variables is – with a few exceptions such as Newham and Hackney – clear. One issue is that the population is typically more transient in the private rental sector than is the case in other tenure sectors and this can cause problems if the recycling system changes over time; for example, residents may not receive the correct instructions on how to use the service unless these are frequently reissued.

There are also clear overlaps between the proportion of flats in a Borough and the proportion of rental properties. It is therefore likely to be difficult to distinguish between the impacts of these two inter-related variables.

Figure A. 7: Population Density against Recycling Performance

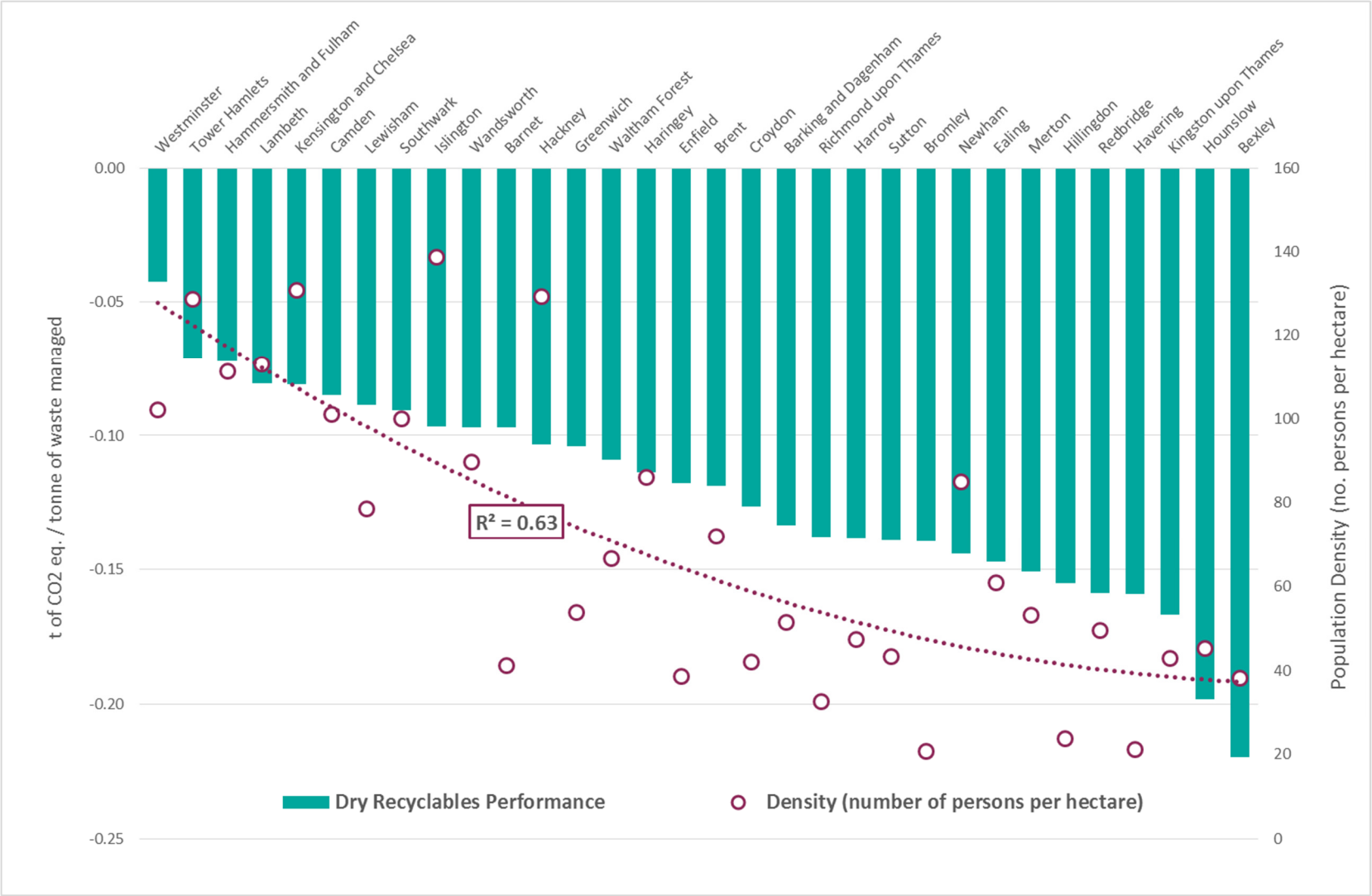
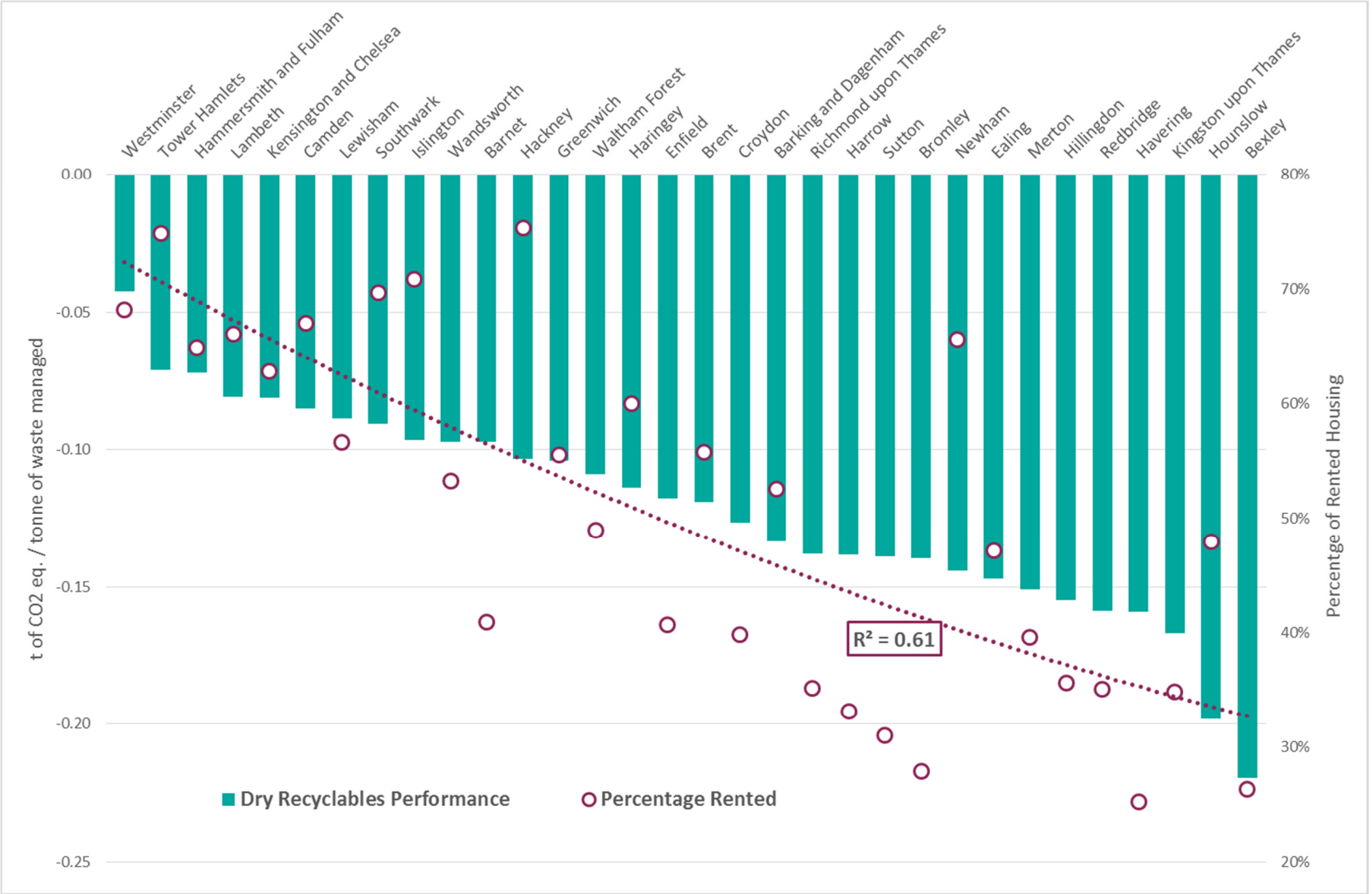


Figure A. 8: Percentage of Rented Properties against Recycling Performance



A.3.4 Relative Performance of Inner and Outer London

Figure A. 9 shows the recycling performance for 'inner' and 'outer' London Boroughs.[26] Here the pattern is very clear, with very few exceptions (one of which is the City of London) the outer Boroughs perform well, whilst the inner Boroughs are clustered towards the bottom of the chart.

Some of the reasons for this differential in performance can be understood through further examination of some of the socio-demographic data presented in the previous sections. For example, the data indicates that the majority of outer London Boroughs have a population density of less than 60 persons per hectare, whilst the majority of inner London Boroughs have a population density of over 100.

Figure A. 10 shows the data on the proportion of flats separated out, so that the pattern for inner and outer London can be seen. With the exception of Lewisham, more than 60% of households in each of the inner Boroughs are housed in flats, whilst for the outer Boroughs this proportion rarely exceeds 50%. There is, however, a spectrum of performance amongst the outer boroughs: for example, both Waltham Forest and Hounslow have similar statistics when the proportion of flat dwellers is considered, but perform very differently with regard to performance against the EPS. This suggests that there are actions that some Boroughs can take in respect of improving the recycling performance in more 'difficult to reach' households.

[26] http://www.londoncouncils.gov.uk/londonfacts/londonlocalgovernment/londonboroughs.htm

Figure A. 9: Recycling Performance of Inner and Outer London Boroughs

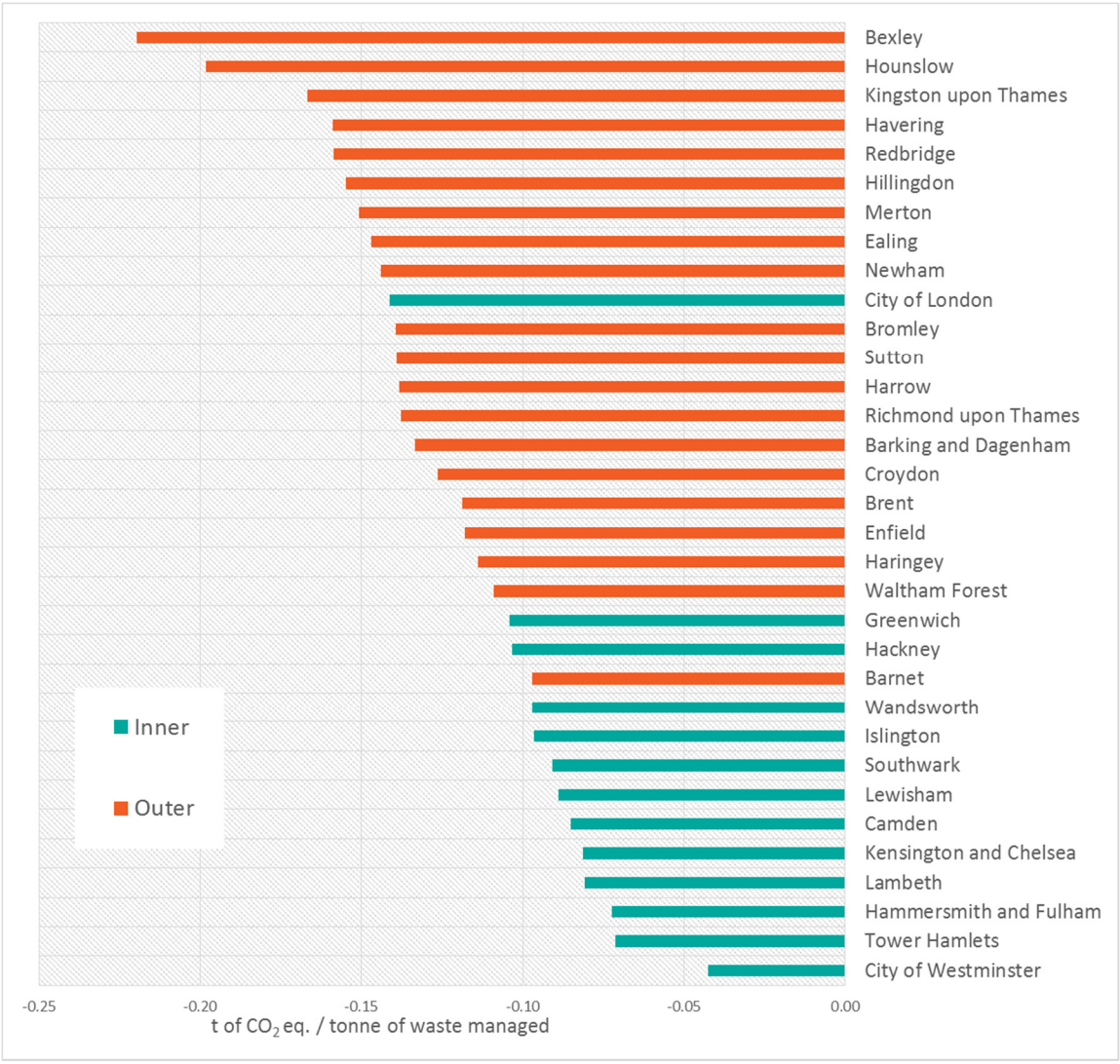
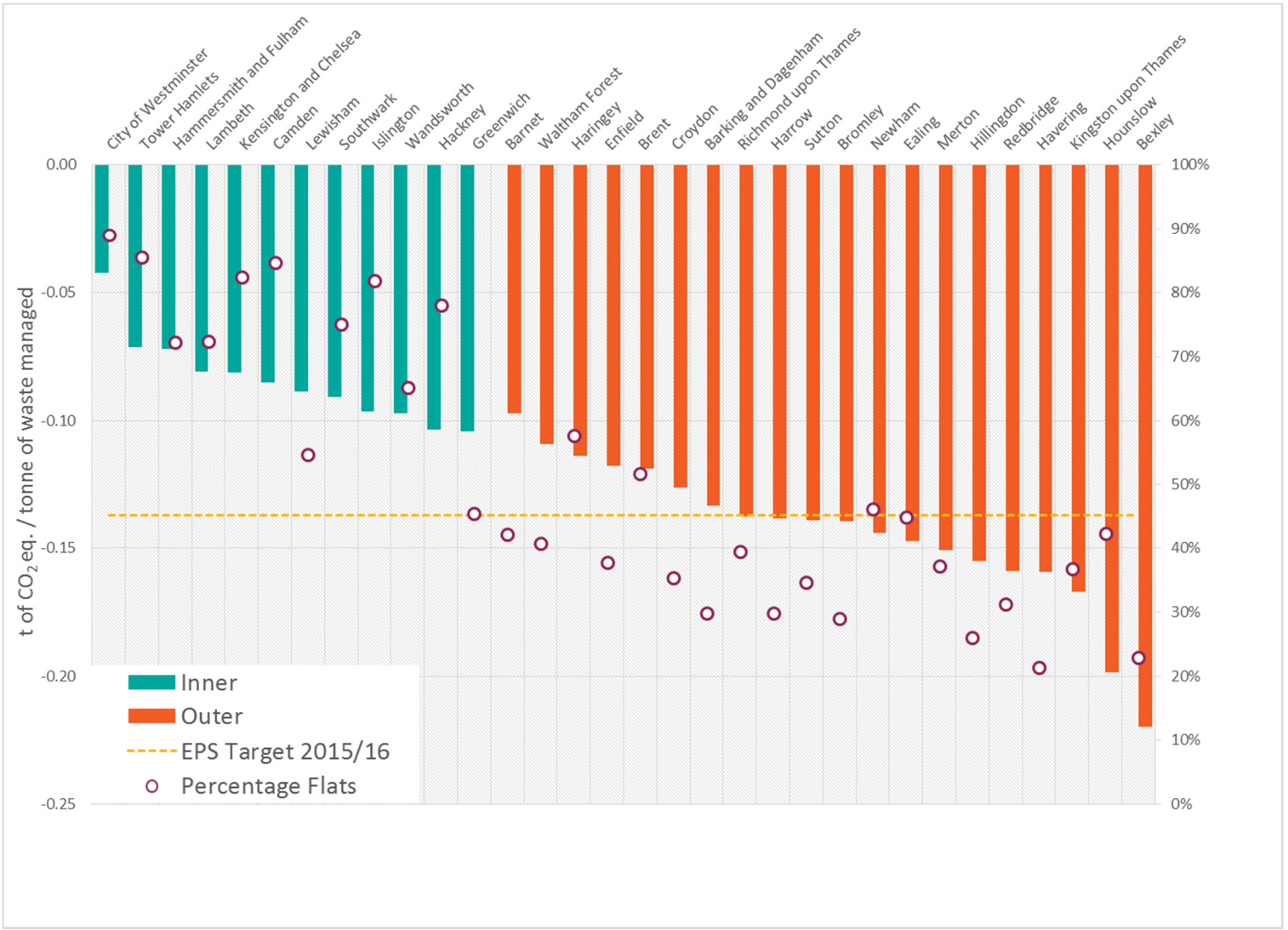


Figure A. 10 – Recycling Performance and Proportion of Flats – Inner and Outer London



A.3.5 Concluding Remarks on Borough Performance

The appraisal of Borough performance undertaken above is largely focussed on an assessment of two-way statistical associations. However, the analysis confirms that the lower performing areas frequently contain a mixture of the demographic characteristics that jointly contribute to low recycling performance. This is summarised by WRAP as follows:[27]

> *Transience, high social mobility, social dis-engagement with 'place' and busy lifestyles are common features of both flat dwellers and young people and these factors combining with the un-promising physical infrastructure of flats conspire to bring together a raft of barriers in one setting.*

These barriers come together in ways that are specific to particular areas, and therefore more sophisticated, multivariate techniques are suggested as being of greater value in practice at a local level than analyses focussing on the more simplistic two-way tabulation. This involves building on the information contained in tools such as Acorn which have developed sophisticated techniques for separating population groups based on the socio-demographic characteristics.[28] Although Acorn data is sometimes used in waste analyses at a local level, the use tends to be limited to the data in its most aggregated form. This not only simplifies the analysis considerably, but also means many of the subtleties are lost – subtleties which are likely to be of value when considering the relationships outlined in the preceding discussion. It was beyond the scope of this study to undertake this type of analysis. However, additional research activity might focus on the further development of this type of approach, focusing on the poorer performing areas in London.

In the absence of this information, key characteristics can nonetheless be identified (at a high level) which are associated with poorer recycling performance, such as flat dwelling and transience. The data presented in this report supports such an assessment.

When tackling these challenging areas, WRAP's work indicates that it is usually sensible to target areas or neighbourhoods. Of relevance to the lower performing London Boroughs, the research highlights that there is a particular need to deal with the challenges associated with flats and the private rental sector. Key areas of consideration for action by the GLA might therefore include the following:

- Development of a service for flats that is designed specifically around the different types of flats in the area and which takes close consideration of the social circumstances and lifestyles of the types of people that live in them;

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[27] M.E.L Research (2014) *Barriers to recycling: A review of evidence since 2008*, Report for WRAP, December 2014

[28] CACI (2014) Acorn Technical Document, May 2014

- Development of tailored communications to ensure that those in the private rented sector can recycle effectively, taking into consideration not only the personal circumstances of these tenants - such as high personal mobility - but the need to address such complications as the landlord's involvement in waste services and facilities; and
- Working with local authorities to develop the business case for new communications programmes or bespoke services for flats to increase levels of recycling. Both such services could be used to reduce the tonnage sent for more costly residual treatment, particularly in instances whereby provision of these services is under long-term contract that does not include a guaranteed minimum tonnage.

The above discussion strongly suggests that investment in communications is likely to be of particular value in communities where the population is transient. Given this, the role of the GLA and that of LWARB's Resource London programme – which supports local authorities in the delivery of waste and recycling services and communications activities – are both likely to become increasingly important in future years.