Greenhouse Gas Emissions Performance Standard for London's Local Authority Collected Waste – 2017 Update

The Greater London Authority

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Report for Adam Batchelor, Greater London Authority

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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 original 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.

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), with the latter applying solely to energy generation from waste. The GLA has also developed a tool for London boroughs to model their performance against the EPS and CIF, called the Ready Reckoner.[1]

The original EPS forecasts were developed based on a number of key datasets including some - such as the national composition dataset - dating from 2006/7. It is now felt appropriate to update the EPS target model, as newer (and more representative) data is available. This report sets out updated EPS targets, which have been developed to better reflect the current and future performance of London's waste management systems, based on the more recent data and projections that are now available.

In addition, the updated EPS will form an important part of the evidence base for the Mayor's new London Environment Strategy (the "Strategy"). The Mayor has a manifesto commitment to increase London's recycling rate from Municipal Solid Waste (MSW) to 65% by 2030. By European definition, this will include the waste collection and disposal activities from:

- Local Authority Collected Waste (LACW), and
- Waste which is of similar composition to household waste

A key change in this version of the EPS in comparison to the previously issued version therefore relates to the inclusion of all LACW activities within the scope of the revised

[1] The tool can be downloaded at www.london.gov.uk/priorities/environment/putting-waste-good-use/making-the-most-of-waste

EPS in respect of waste management, including commercial waste collected by local authorities for recycling. It is important to note that the Mayor's recycling target is set such that it applies to MSW. Therefore, included within the scope of the target is commercial waste similar in composition to household waste but not collected by local authorities. However, information on the collection of this material is not currently publicly available in the same way that information on LACW is (via Waste Data Flow (WDF), for example). Since it is not therefore currently possible to measure progress against an EPS target which includes this non-LACW category of material, we have modelled performance assuming a recycling target of 50% by 2025 for LACW only. To ensure a similar level of ambition is retained in this version of EPS as was the case in the previous version, the EPS target for 2030 is set assuming an aspirational target of 60% recycling for London's LACW is achieved.

In Section 2.0 of this report, we set out the key changes that have been made in respect of the calculation methodology for the EPS in comparison to the methodology previously published in 2011.[2] In making these changes we have sought to better reflect a realistic level of performance that can be achieved by different elements of the waste management system under current operating conditions and within the prevailing policy environment, whilst retaining the ambition of the previous target. We have also sought to align the EPS and CIF targets with one another in the target years.

In Section 3.0 we discuss revisions to the CIF target. This includes the calculation of a CIF baseline for 2015/6. Section 4.0 sets out the new EPS targets calculated with the revised assumptions summarised in Section 2.0.

Along with the updates set out in this report, we have also produced an updated version of the Ready Reckoner.

2.0 Revisions to the EPS

This section sets out the changes that have been made to the EPS targets in comparison to the targets included in the first version published in 2010. Key changes include:

- An increase in the scope of the EPS to include additional commercial waste collected by local authorities and re-use – discussed in more detail in Section 2.1;
- Updates to the methodology used when setting the EPS – discussed in more detail in Section 2.2.

[2] Eunomia Research & Consulting (2011) Development of a Greenhouse Gas Emissions Performance Standard for London's Municipal Waste – Revised Report, Final Report for the GLA, June 2011

2.1 Scope

As noted in Section 1.0 the scope of the EPS has been expanded to include both commercial waste collected by local authorities and the benefits of re-use. Waste Data Flow (WDF) is a key source of information on the performance of local authorities against the EPS, being used to calculate the performance of London authorities against the EPS on an annual basis. Data on commercial waste collected by local authorities is included within WDF, although data recording practices vary across the different boroughs. The WDF data also includes tonnage collected for re-use by the boroughs. More information on the methodology used to model these additional waste streams is set out in Section 2.2.

2.2 Methodological Updates

2.2.1 Mass Flow Changes

2.2.1.1 Revised Composition Datasets

The original EPS was modelled using composition data on the whole waste stream for household waste from the Defra national composition dataset of 2006. This was then updated for future years in the EPS, based on the updated levels of recycling required to meet the forward looking targets out towards 2030.

Compositions for LACW, Waste from Households and commercial waste were built up from compositional datasets for different waste streams.

For its 'waste from households' composition, the updated EPS uses residual composition datasets from London boroughs and London waste authorities taken from the past few years to model wastes collected at the kerbside from households and wastes collected from HWRCs. This includes the following datasets:

- M.e.l. Research (2016) ELWA Kerbside Residual Waste and Recycling composition analysis, Final Report for ELWA, November 2016;
- Amec Foster Wheeler (2016) North London Waste Authority Residual Waste Composition Analysis 2016, Final Report; and
- Resource Futures (2014) Western Riverside Waste Compositional Analysis, Report for WRWA.

Additional residual compositional data on some Unitary Authorities were sourced from work recently undertaken with these authorities.

There is less data available on the residual waste composition of commercial waste compared to household waste, although information on the tonnages collected for recycling is available from the same sources as that of household for the local authority collected wastes. The composition of residual waste from the commercial streams was modelled based on a number of datasets for the different commercial waste streams, including:

- DEFRA (2012) Updated compositional estimates for local authority collected waste and recycling in England, 2010/11, report by Resource Futures;
- Entec (2010) Waste Composition Analysis Project for NLWA, Final Report for the North London Waste Authority, October 2010;
- Zero Waste Scotland (2012) The Composition of Mixed Waste from Scottish Health and Social Care, Education, Motor, Wholesale and Retail Sectors in 2011, Final Report, May 2012;
- WRAP (2011) The Composition of Waste Disposed of by the UK Hospitality Industry, Final Report, July 2011; and
- J. Walker (2014) Commercial Waste and Street Sweeping Compositional Analysis 2013-2014, Report for Westminster City Council.

These data sources on residual waste collected were supplemented with 2015/16 tonnage data from WDF on separately collected waste streams (for waste from households, C&I waste and LACW overall as appropriate):

- WDF data was used for materials collected separately for recycling and composting;
- Co-mingled tonnages from WDF data were disaggregated into material streams using a composition applying:
    - non-target and non-recyclable rates from WRAP's Material Facility Reporting portal - this is felt to be a more reliable source of information than composition studies as it is based on more regular sampling of the streams;[3] and
    - a composition of recycled material taken from WDF Question 100 data on material recycled from co-mingled recycling collections.

For other non-household-collected waste streams identified within WDF (including litter and streets sweeping, fly tipping, parks and grounds waste and gully waste), a similar approach has been taken to combine WDF data with best available residual composition estimates, including from the Entec and Westminster reports referenced above.

For all streams, future compositions in the model are derived through modelled changes in recycling capture of the recyclate streams, with a trajectory that is set such that a recycling target of 50% is met by 2025 for LACW, and an aspirational recycling target of 60% is met by 2030.

As has been set out in the discussion in the EPS update reports published in 2015 and 2016, the newer household composition datasets (including those used to calculate this version of the EPS) contain less recyclable paper than the original data used within the EPS. This therefore affects the amount of material available for capture by household recycling systems, as well as the carbon performance. The more recent household waste composition also includes more plastics, more glass and more organics (levels of food

[3] Available from http://mfrp.wrap.org.uk/

waste are higher). Some of these changes are offset to a certain extent by the inclusion of commercial waste: this stream has more paper, less food and garden waste, and more wood than the newer household waste composition – as well as more plastics.

2.2.1.2 Recycling from Households

The previous version of the EPS included some ambitious targets in respect of capture of recyclables from households, based on the better performing systems seen in European cities. In practice, many of these systems are operating under very different policy environments to that of London, with additional policies in place that are likely to assist with the achievement of these higher rates.[4] In addition, some areas of London have a relatively high proportion of hard to reach properties (such as flats), and relatively low levels of garden waste. These factors make it harder for London boroughs to achieve high levels of recycling from households at the kerbside than is the case for other areas both inside and outside of the UK.

For this update of the EPS, a household waste recycling rate target has been set using the results of a modelling exercise undertaken by WRAP, commissioned by Resource London.[5] The exercise was aimed at determining a realistic level of increase in recycling rates for waste collected from households in London through to 2030 based on a set of collection service change scenarios selected to deliver increased recycling captures. These changes include the introduction of separate food waste collections, restricted residual containment capacity and frequency, collection of a single set of main dry recyclable materials (glass, cans, paper, card and plastic bottles and in some scenarios household plastic packaging) in either single, twin-stream or comingled collections and an assumed increase in recycling performance for high rise properties (of either 20% or 40%).

The modelling assumes a continuation of the prevailing national policy environment with regards to household collections. It also assumes there are no key additional national policy drivers that might result in a more significant shift in performance, such as the introduction of pay as you throw systems.

The starting position of each borough is taken into account with regards to setting a realistic timescale over which they would be expected to be able to transition to a new enhanced recycling collection service. For example, if the borough has an outsourced collection contract, the expiry date of that contract is taken into account when modelling the earliest year that a service change would be possible.

For each scenario modelled, a future recycling rate is calculated as is an estimated net service cost (against a business as usual scenario). The highest performing scenario

[4] For example, European cities with higher recycling performance have frequently employed measures such as pay as you throw systems and deposit refund on some packaging/containers which provide additional incentives for householders to recycle more waste than is the case in the UK.

[5] WRAP (2016) London Route Map Project – Update 2016, Report for Resource London

modelled in terms of recycling rate of household waste is forecast to achieve a 42.2% recycling rate by 2022 (ahead of target year 2025).[6] This scenario involves the following service changes:[7]

- All low-rise (kerbside serviced) properties moving to separate weekly food waste collections, with restricted residual waste through fortnightly collections and reduced containment.
- All low-rise (kerbside serviced) properties receive, as a minimum, the collection of six main dry recyclable materials (glass, cans, paper, card, plastic bottles and household plastic packaging);
- All high-rise properties receive, as a minimum, the collection of five main dry recyclable materials (glass, cans, paper, card and plastic bottles) and performance assumed to increase by 40%.

Although much lower than the targets modelled for household streams in the previous EPS, this is nonetheless felt to be a relatively challenging target for many boroughs to meet in the current policy and funding environment.

Meeting the aspirational target of 60% recycling by 2031 is anticipated to require further improvements in the performance of household waste recycling services in addition to the above service changes set out above, assuming substantial additional investment in pre-treatment facilities is to be avoided.[8] We have therefore assumed a further increase in performance, such that these services achieve a 44.2% recycling rate by 2031, driven by further collection system improvements, a further tightening of residual waste policies, and further targeting of materials where existing capture is relatively poor (e.g. textiles, hard plastics).

The above scenario from Resource London's modelling results in the highest overall tonnage of dry recycling collected from households (by 2022) of all the scenarios modelled, as well as the highest tonnage of all of the higher carbon materials (plastics, metals, textiles). This scenario is therefore also expected to result in the best performance against the EPS in respect of dry recycling from households.

Resource London's work considered other scenarios in respect of improving London's future performance in respect of recycling. The second best performing scenario indicated that London's households would achieve a 40% recycling rate by 2022. It will be seen in Section 2.2.1.3 that the achievement of 42.2% household recycling by 2022 leaves a considerable shortfall in respect of meeting the aspirational target of recycling 60% of London's LACW by 2030. Clearly this gap will be even more significant if households achieve only 40% by 2022. The lower levels of performance of the household

[6] The target is assumed to be calculated based on material actually recycled (as opposed to material collected for recycling) – Why is this relevant/necessary? Suggest deleting
[7] Scenario '1b, 5a, 6c'
[8] The contribution of residual waste pre-treatment infrastructure to recycling rates is discussed further in Section 2.2.1.4

collection service seen in this alternative scenario are such that the level of ambition required, in turn, from local authority commercial waste collections is felt to be too substantial to be realistic. As such, it is felt that the highest performing scenario modelled by WRAP is the only practical scenario that can be considered if the aspirational target for 2030 is to be met.

2.2.1.3 Contribution from Commercial Waste

Section 2.2.1.2 suggests that the maximum recycling rate of 42.2% from households modelled in the Resource London work will leave a shortfall against the 50% LACW target, and a bigger gap still in respect of achieving the aspirational 60% target. This will require boroughs to achieve additional recycling performance, which will need to be sourced from other streams other than that collected from households at the kerbside. It is assumed that some of this shortfall will be made up by local authorities collecting and recycling increasing amounts of commercial waste through the existing local-authority operated commercial recycling schemes.

At present, most local authorities collect a small proportion of the commercial waste generated within their boundaries. A recent commercial waste arisings forecast produced by Eunomia for NLWA using borough-collected commercial waste data reported to WDF, suggests the current local authority market share of commercial waste across London is around 13%.[9] Data reported to WDF suggests levels of recycling of borough-collected commercial waste are low compared to household recycling, at around 10%-17%.

There is some uncertainty surrounding the composition and treatment of this commercial waste. However, it is felt there is scope to increase the levels of recycling – the initial version of the national waste survey suggested an overall commercial and industrial recycling rate of 48% whilst the more recent survey undertaken in Wales indicated an overall recycling rate for C&I wastes of 58%.[10] Data recently presented by the GLA similarly suggested that recycling rates across London as a whole – including commercial waste not collected by local authorities – to be around 52%, with the contribution from commercial waste being based on London's data from the national C&I survey.[11] This suggests a focus on developing enhanced commercial waste recycling collection services by London boroughs to be one - relatively cost effective - way in which some of the shortfall in recycling against the 50% recycling rate target at a local authority level could be addressed.

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[9] This work was undertaken as part of the need assessment published by NLWA in 2015, as part of the planning process for the new facility, see: NLWA / Eunomia / Arup (2015) North London Heat and Power Project: Need Assessment, October 2015

[10] Jacobs (2011) Commercial and Industrial Waste Survey 2009, Final Report; RSK and Urban Mines (2013) Industrial and Commercial Waste Generated in Wales 2012

[11] GLA (2017) Keynote Address: The Mayor's Aspirations for Waste and Recycling, presentation by Andrew Richmond at The London Conference, Cavendish Conference Centre, London, 16 March 2017

When modelling the potential increase in commercial waste activity by London boroughs, we have based our assumption on an increase in the market share informed by initiatives underway through the London Business Waste and Recycling Programme.

The model assumes a 50% increase in commercial waste collected by local authorities from 437,000 tonnes in 2015/16 up to 688,000 tonnes by 2024/25 in line with London Business Waste and Recycling Programme ambitions.[12] In order to meet the 2025 recycling target, overall recycling rates for commercial waste collected by local authorities needs to improve from the current 13% average to 40%. These rates are well within an achievable range (and below average commercial recycling rates in London more broadly) so long as local authority commercial waste services are developed with a clear focus on recycling performance.

To meet the aspirational target of 60% recycling for LACW by 2030/1 will require further ambition in respect of recycling collected from local authority commercial waste services. To meet this target, we have assumed all of these services achieve a recycling rate close to 65%. This will require the spread of best practice on commercial waste recycling to all commercial waste services operated by local authorities.

2.2.1.4 Tonnage Data on Waste Treatment Systems

Data on the current quantities of waste being sent to different residual waste and organic treatment systems is taken from WDF. Changes in the treatment of residual waste in the future have been modelled based on data from our residual waste treatment database, as well as our knowledge of forthcoming activity from work undertaken with the London waste authorities. The previous version of the EPS assumed a greater shift towards Mechanical Biological Treatment (MBT) over the course of the target period than is now anticipated to be the case in practice based on current WDF data and expected contractual changes; the latter suggests that a significant proportion of London’s waste will be treated using incineration by 2030. This has resulted in a further change in the EPS calculations, reflecting the expected change in trajectory in respect of how London’s waste is being treated in practice. Assumptions regarding the energy generation performance of London’s EfW facilities have also been updated – this is discussed further in Section 3.0.

To ensure the aspirational target of 60% recycling of LACW is met by 2030/1, we assume that more recycling is recovered from residual waste through the development of additional advanced pre-treatment infrastructure. It is assumed that a total of 30% of residual waste collected by local authorities is treated by this method in 2030/1 – largely

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[12] Waste statistics data generated by Defra indicate there to be 619 thousand tonnes of non-household waste collected by local authorities in London in 2015/6, with this category also including streams such as street cleaning, fly-tipping, non-household wastes from HWRCs and rubble collected from households. The scope of the EPS excludes these waste streams. Commercial waste arisings in the EPS include recycling collections reported under Question 11 of WDF (43,000 tonnes in 2015/6) and residual waste reported under Question 23 of WDF (394,000 tonnes).

achieved by a combination of a new facility with better pre-treatment performance replacing the existing MBT contract in East London. An additional shift to pre-treatment of non-household waste is also assumed to occur to meet the requirement of no waste to be sent directly to landfill by 2026.

2.2.2 Changes in Life Cycle Methodology

The EPS is calculated by linking an emissions model to the mass flow model which accounts for the changes in tonnages through the scenarios as set out in Section 2.2.1. This model uses the life cycle assessment (LCA) methodology when developing estimates of the climate change impacts of the approach to waste management. Carbon outputs are calculated using the global warming potential indicator. 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_2 eq.) for measurement against the EPS.

The original version of the EPS was developed using the life cycle assessment tool WRATE, which was originally developed by the UK's Environment Agency. The decision to use WRATE in the original version of the EPS was based on this being used in local authority procurement processes. In developing WRATE, the aim of government was to allow for a certain standardisation of the outputs of studies undertaking the LCA of waste during these procurement processes. However, the use of user-defined models in WRATE – developed to more accurately reflect the actual performance of different treatment technologies operated by different parties – means that in practice, outputs are nonetheless still largely bespoke, and therefore not well standardised. In addition, WRATE is no longer owned by Environment Agency, and is not now being updated on a regular basis. Whilst model users have considerable control over how energy from waste technologies are modelled, there is far less control over other key datasets such as those considering landfill and recycling, all of which now require updating to a greater or lesser extent. In addition, WRATE does not include any data on the benefits of re-use, which is now also included within the scope of the EPS.

In re-setting the EPS, the decision was therefore taken to use Eunomia's in-house tools as the basis for undertaking the life cycle assessment of residual waste treatment and source segregated organics recycling.[13] For most waste treatment methods – including incineration, MBT, AD and composting - the change in life cycle assessment tool has relatively little net impact on the results of the assessment, as the previously developed user defined WRATE models were derived from modelled outputs that originated in our in-house tool. More significant changes were associated with the approach to modelling

[13] Updated assumptions to both reports that are of relevance to the current project are set out in Appendix A.1.0.

the landfill of untreated wastes; this is set out in Appendix A.1.0.[14] We have also updated the recycling benefits datasets to use the more recent data contained in the Scottish Carbon Metric; this brings the current version of the EPS calculations in line with both the Metric and Eunomia's Recycling Carbon Index as far as the calculation of recycling benefits is concerned.[15]

A number of other updates have been made to the life cycle assessment factors, reflecting further data updates:

- The marginal carbon intensity data for the residual waste treatment and source segregated treatment models has been updated for the target years, in line with government guidance on the long-run marginal carbon intensity for electricity generation.[16] Assumptions are presented in Appendix A.1.0;
- Assumptions on the efficiencies of energy generation for electricity and heat have been revised for both current and future performance. This is discussed further in Section 3.0.
- Updates to transport model emissions factors have been made to reflect the anticipated reduction in emissions in HGVs based on the expected shift towards lower carbon transport out to 2030. In this respect, we assume a 25% reduction in the carbon impact associated with road transport in 2030.
- The residual waste treatment models have also been recalculated using the revised residual waste composition data generated as was set out in Section 2.2.1.1.

Data on the benefits of re-use has been taken from WRAP's work on the Benefits of Re-use.[17]

Revised emissions factors for the key streams and treatment systems are presented in Appendix A.1.0. It is important to note that – for the most part – the changes in the methodology have resulted in relatively little overall change to the emissions factors in comparison to those used in the last EPS, as the differential impacts from the changes have, in many cases, resulted in various impacts offsetting one another. This is the case even where emissions from landfill are concerned. Exceptions to this are the changes in composition and in the carbon intensity of the marginal source of generation, both of

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[14] The approach to developing the landfill module is set out in Eunomia / Oonk (2011) Inventory Improvement Project – UK Landfill Methane Emissions Model, Final Report to Defra / DECC. The overall approach to developing the remaining models is set out in the Appendices of the Economic Modelling report – see Eunomia (2010) Economic Modelling for the Mayor's Municipal Waste Management Strategy, Report for the GLA.

[15] It is important to note that the Recycling Carbon Index is different in scope to the EPS as the latter includes the impact of residual waste treatment, as well as commercial waste collected by local authorities

[16] The toolkit containing the relevant values is available from: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[17] WRAP (2011) Benefits of Reuse Case Studies

which have a more significant impact on the carbon impacts from EfW systems (including MBT systems where a fuel stream is produced and sent for incineration).

3.0 Updated CIF Target

3.1 CIF Baseline

To assist in setting the revised CIF, an initial task was to calculate London's energy from waste treatment facilities performance against the current CIF. The following approach was used in calculating the impacts for the residual waste facilities:

- Data was collected on the energy generation efficiency of London's key EfW facilities in 2016, based on publicly available information taken from the annual performance reports of these facilities. The development of a weighted average of this data suggested that the current energy generation performance of these facilities is equivalent to a gross electrical generation efficiency of approximately 26%.[18]
- Emissions from residual waste treated at the capital's EfW facilities were calculated based on the updated London-wide composition as discussed in Section 2.2.1.1.

Data on the emissions and energy generation from AD were derived from the existing LCA models within the EPS. AD facilities comfortably meet the CIF due to the feedstock being 100% organic and it therefore being deemed 'carbon neutral'.

The above analysis of London's incinerators suggests that current performance is around 700 g CO_2 eq. / kWh electricity, based on current composition and energy performance data. There are two key factors for this performance being well over the CIF level:

1) Large quantities of materials with a high embodied carbon (particularly plastic) being in the residual waste stream; and
2) London's incinerators operating largely operating in power only mode (with the exception of the SELCHP incinerator distributing a small amount of waste heat).

Performance against the CIF improves significantly when materials with a high embodied carbon are removed from residual waste sent to energy generation and where the heat is captured alongside the electricity, thereby improving the overall efficiency of the energy facility

[18] Veolia (u.d.) SELCHP Energy Recovery Facility: Annual Performance Report 2014; Cory Environmental (u.d.) Riverside Resource Recovery Facility: Annual Performance Report 2014; Lakeside EfW (u.d.) Annual Performance Report for Lakeside EFW Ltd; Arup (2015) North London Heat and Power Project: Combined Heat and Power Development Strategy, Report for North London Waste Authority October 2015

3.2 Revision to the CIF Target

The current CIF target of 400 g CO_2 / kWh, was set in line with what was considered the marginal electricity generation source at the time of setting the original EPS 2011. The marginal source was assumed to be equivalent to the performance of electricity generation using a Combined Cycle Gas Turbine power plant. The above calculations confirm that London's current performance is still some way short of achieving this target. However, both internal data provided by the GLA and publicly available information confirms that most boroughs are now making some progress towards developing CHP capacity.[19] The available analysis suggests that there is considerable potential for the further development of CHP infrastructure with support from boroughs and the GLA.

By way of examples: the proposed new energy recovery facility in Edmonton will be of a higher generation efficiency than the facility it will replace, and documents submitted to the Planning Inspectorate suggest that it is intended that its performance is in line with the existing CIF target. Based on planning documents this plant is assumed to come into operation in 2025. The Beddington incinerator is also expected to come on line at around the same time and it is expected this facility's performance will be similar to that of the new Edmonton facility. By 2020, it is anticipated that a reasonable proportion of London's facilities will be operating in CHP mode to a certain extent; by 2025, on the basis that both SELCHP and Riverside also make appropriate levels of progress in respect of the plans to develop CHP infrastructure, it is assumed that all facilities will meet the CIF target of 400 g CO_2 / kWh. This performance is assumed to be maintained out to 2030, although there is also be scope to extend the CHP infrastructure beyond that modelled here. Associated assumptions for the energy generation performance of incineration are set out in Table 3-1.

Table 3-1: Energy Generation Assumptions for Incineration in London

	2016	2020	2025	2030
Electricity generation efficiency (gross)	26%	26%	26%	26%
Heat generation efficiency		5%	15%	15%

Sources: Waste Data Flow; Veolia (2015) SELCHP Energy Recovery Facility Annual Performance Report: 2014; Cory Environmental (2015) Riverside Resource Recovery Facility: Annual Performance Report: 2014; Arup (2015) North London Heat and Power Project – Combined Heat and Power Development Strategy,

[19] Sutton Decentralised Energy Network (u.d.) Low Carbon Energy for South London; Arup (2015) North London Heat and Power Project: Combined Heat and Power Development Strategy, Report for North London Waste Authority October 2015

Report for the North London Waste Authority; Sutton Decentralised Energy Network (u.d.) Low Carbon Energy for South London

The UK is making progress in decreasing the carbon intensity of its electricity generation, and as such, BEIS has produced a revised trajectory of the carbon intensity of the marginal source of electricity generation which provides data in this respect out to 2100. This dataset confirms that the carbon intensity of marginal source of electricity generation in 2030 is projected to be 118 g CO_2 / kWh. This suggests that the current CIF target would need to be reduced considerably out to 2030, assuming the aim continues to be that EfW should be no less polluting than the marginal source.

However, given current performance levels set out in Section 3.1, all boroughs will need to make considerable progress if they are to meet the current CIF target of 400 g CO_2 / kWh. As such, it is not felt to be feasible to reduce the current CIF target prior to 2025. After this point, as was set out in Section 2.2.1.3, in order to meet the aspirational 60% LACW by 2030, a further increase in commercial waste recycling is assumed. This is expected to increase the recycling of both plastic film and plastic bottles somewhat, thereby reducing the carbon intensity of the residual waste stream. It is also assumed that London develops additional pre-treatment capacity, as was set out in Section 2.2.1.4. This infrastructure will contribute towards meeting London's recycling targets as well as reducing the carbon intensity of energy generation at London's EfW facilities. Taken together, these additional steps could result in an overall achievement across all of London's incineration facilities of a CIF performance of around 302 g CO_2 / kWh. This value could be considered as the new CIF target for London for 2030.

With this additional target in place, the CIF results in the following climate change benefits in respect of all of London's EfW treatment capacity for municipal waste, based on the tonnage of municipal waste treated in each respective target year and calculated in respect of a baseline of 700 g CO_2 / kWh electricity,:[20]

- 441,893 tonnes CO_2 eq. in 2025;
- 586,245 tonnes CO_2 eq. in 2031.[21]

[20] Calculations based on 1.5 million tonnes of waste being treated via EfW, assuming energy generation efficiency as set out in Table 3-1. The savings are calculated with reference to the tonnage of municipal waste treated in each target year, as well as with reference to the cumulative carbon savings achieved through the reduction in the carbon content of the feedstock (through recycling) and improvements in energy generation performance.

[21] Section 4.0 considers these outputs in comparison with the carbon savings achieved through the EPS, including a consideration of the overlap between the two elements.

4.0 Revised EPS Targets

Revised EPS targets are presented in Figure 4-1. The graph also shows the previous targets on the same chart for comparison purposes. The revised targets include impacts from re-use (based on tonnages recorded in WDF) and the impact of the aspirational 60% recycling rate target for LACW in 2030/1.

Figure 4-1: Revised EPS Targets

The remodelled EPS results in lower targets for 2015/6 and 2020/1, as a consequence of the lower recycling rate for wastes collected at the kerbside than was the case in the previous version of the EPS for both of these target years. An additional target has also been introduced for 2024/5, in order to more clearly demonstrate the trajectory in performance required between 2024/5 and 2030/1. The increase in performance of the EPS in the latter period is driven in large part by additional re-recycling and pre-treatment (including some improvement in the operation of existing facilities) to recover more materials for recycling. A summary of the key changes in the mass flow against the milestone years is provided in Table 4-1.

The revised version of the EPS includes an increasingly significant contribution from commercial waste from 2021/2. The contribution of this component to the overall EPS in the different target years can be seen in Figure 4-2. Note that at the current time, most commercial waste services offered by local authorities are focussed on residual waste services rather than recycling; as such, in 2015/6, commercial waste results in a net *contribution* to emissions rather than a net benefit arising from increased recycling.

Practical considerations surrounding the contribution of commercial waste to the EPS are discussed further in Section 5.0.

Table 4-1: Mass Flow Assumptions for Target Years

Target year	Key assumptions for EPS 2017	EPS 2011
2015/6	Overall LACW recycling rate of 30%.	LACW recycling rate of 46%
2020/1	Overall LACW recycling at 47%. Household recycling rate at 41%.	LACW recycling rate of 51%
2024/5	Overall LACW recycling at 50%. Assumes 42.2% recycling from households; the remaining recycling from LAC commercial waste (recycling rate of 39%) and from residual waste, including some pre-treatment. Additional incineration and increased roll out of CHP (assumptions as per Table 3-1).	N/A
2030/1	Aspirational target of 60% of LACW waste recycled. Assumes 44.2% recycling from households; the remainder largely from LAC commercial waste (recycling rate of 65%) and from residual waste (30% of residual waste sent for advanced pre-treatment). No waste sent direct to landfill; no waste sent to MBT. 20% reduction in food waste arisings from households.	LACW recycling rate of 61% 51% of residual waste sent to MBT / MHT, remainder to EfW

Figure 4-2: Breakdown of LACW Elements for the Revised EPS

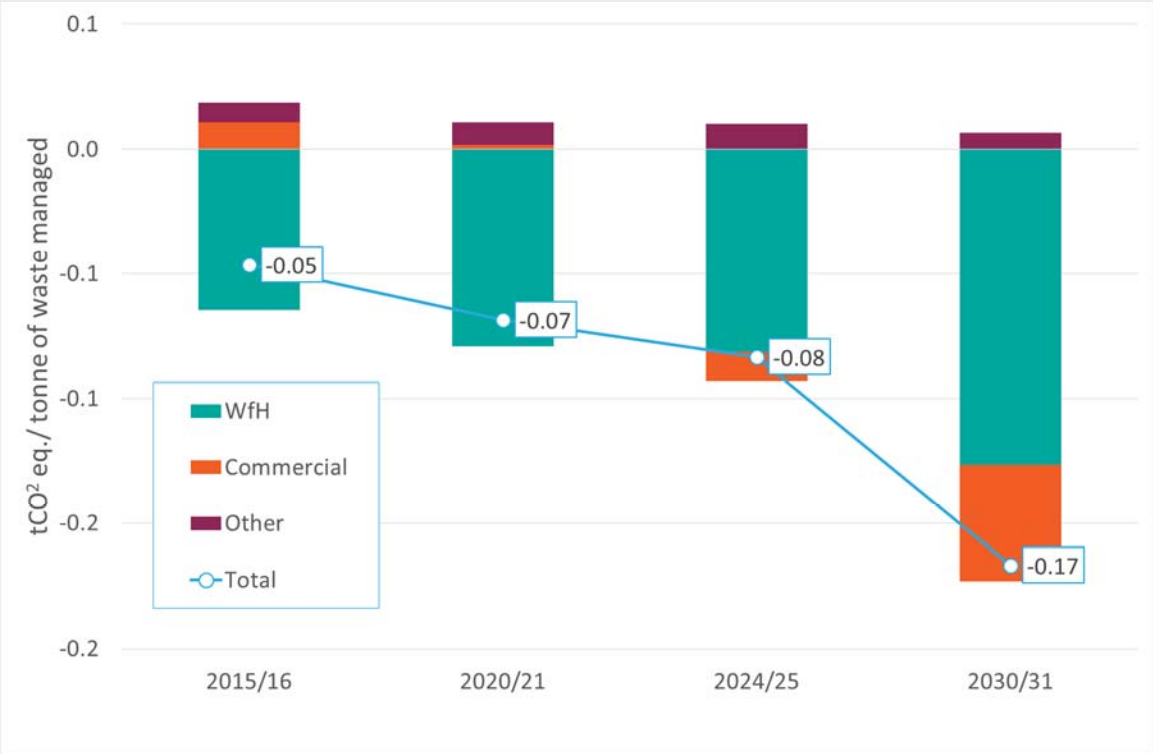

Table 4-2 shows the tonnes of waste managed and the carbon impacts of the various EPS components at each of the target years. The table confirms the amount of waste sent to recycling increases over time and waste incineration increases slightly from 2024/5 to 2030/1; the increase at this point is assumed to occur as a consequence of both increased recycling and the GLA's policy for no waste to be sent directly to landfill from 2026 onwards.

Further comparisons between the outputs of the two versions of the EPS are summarised in Table 4-3. Comparisons are made here on the basis of the calculation of the target for 2030/1 – at which point the two versions of the EPS include similar recycling targets. The data in Table 4-3 confirms that the overall EPS target in this version of the EPS has been reduced for target year 2030/1: from -0.238 tonnes CO_2 eq. / tonne of waste treated in EPS 2011, to -0.167 tonnes CO_2 eq. / tonne of waste in EPS 2017.

The data in the table confirms the most significant contributor to this change is the reduction in the benefit that is derived from energy from waste facilities, as a result of the decrease in the carbon intensity of the marginal source of generation.[22] In consequence, impacts associated with residual waste treatment have increased in this

[22] Data is provided in **Table 5-1** in this respect

Table 4-2: Tonnages and Carbon Emissions from Waste Management in Target Years

	Waste Management Activity	Waste Managed (ktpa) in 2015/16	Associated Emissions (ktCO2e) in 2015/16	Waste Managed (ktpa) in 2020/21	Associated Emissions (ktCO2e) in 2020/21	Waste Managed (ktpa) in 2024/25	Associated Emissions (ktCO2e) in 2024/25	Waste Managed (ktpa) in 2030/31	Associated Emissions (ktCO2e) in 2030/31
Residual	Landfill (inc. residues)	707	132	508	100	485	97	444	90
	Incineration	1,530	177	1,635	219	1,594	240	1,653	291
	MBT	365	40	347	45	336	41	1	0
	Total Residual	**2,602**	**349**	**2,491**	**364**	**2,415**	**379**	**2,098**	**381**
Organic	Anaerobic Digestion	62	-9	186	-25	208	-26	300	-43
	In-vessel Composting	110	-3	116	-3	120	-3	125	-4
	OAW Composting	150	-8	186	-10	194	-10	216	-11
	Total Organic	**322**	**-20**	**488**	**-38**	**522**	**-39**	**641**	**-58**
Re-use	Textiles	5	-28	5	-28	5	-28	5	-28
	Furniture	3	-1	4	-1	5	-1	5	-1
	WEEE	0	-1	0	-1	1	-2	1	-2
	Total Reuse	**7**	**-29**	**9**	**-30**	**10**	**-31**	**10**	**-31**
Recycling & reprocessing	Paper / Card	336	-115	448	-153	532	-182	652	-223
	Glass	133	-27	181	-36	214	-43	256	-51
	Metals (ferrous)	31	-56	34	-62	38	-69	59	-108
	Metals (non-ferrous)	13	-114	14	-126	16	-137	26	-226
	Plastics	69	-81	89	-105	105	-123	191	-223
	Textiles	11	-67	12	-71	13	-75	21	-127
	Wood	63	-26	74	-30	78	-32	99	-41
	WEEE	21	-4	24	-4	25	-5	26	-5
	Other	76	-10	94	-13	106	-15	152	-21

	Waste Management Activity	Waste Managed (ktpa) in 2015/16	Associated Emissions (ktCO2e) in 2015/16	Waste Managed (ktpa) in 2020/21	Associated Emissions (ktCO2e) in 2020/21	Waste Managed (ktpa) in 2024/25	Associated Emissions (ktCO2e) in 2024/25	Waste Managed (ktpa) in 2030/31	Associated Emissions (ktCO2e) in 2030/31
	Total Recycling and Reprocessing	**753**	**-500**	**971**	**-602**	**1,127**	**-681**	**1,482**	**-1,025**
	All Transport	N/A	28	N/A	33	N/A	31	N/A	27
	Total	3,686	-171	3,961	-272	4,076	-340	4,233	-706

Table 4-3: Comparison of Results of the Two EPS Versions – Target Year 2030/1

	Results of EPS – tonnes CO_2 eq. per tonne of LACW managed		Summary of reasons for the differences in 2030/1
	EPS 2017	EPS 2011	
Transport	0.006	0.010	EPS 2017 assumes a reduction in carbon impact as a result of plans and policies in place to reduce carbon intensity of transport fuel.
Re-use	-0.007		Addition to scope of EPS 2017 from previous iteration of EPS, although some re-use of textiles was included under recycling in EPS 2011.
Dry Recyclables	-0.242	-0.257	Changes in the composition of collected recyclables result in a change in outputs for EPS 2017 (despite similar recycling targets being in place for both versions of the EPS by 2030). EPS 2017 has slightly less dry recyclables as well as a lower proportion of materials being recycled with relatively high carbon benefits for 2030 - including less metals and textiles, as well as significantly less paper (although it does result in the recycling of more plastics than EPS 2011). There is also a greater contribution from the “other” category which is associated with a relatively low carbon benefit. Composition data reflecting the key materials recycled is provided in Appendix A.1.0.

	Results of EPS – tonnes CO_2 eq. per tonne of LACW managed		Summary of reasons for the differences in 2030/1
	EPS 2017	**EPS 2011**	
Organics	-0.014	-0.010	For EPS 2017, greater benefits modelled of utilising compost and digestate offset the impact from the lower carbon intensity of electricity for AD plant generating electricity, and an increase in the collection of organics due to composition changes.
Incineration	0.069	0.005	Greater tonnage of waste sent for incineration in EPS 2017. EPS 2017 also assumes a lower carbon intensity of the marginal source of electricity generation in 2030, meaning that the carbon impacts of incineration are also higher on a per-tonne of waste basis. (Data on respective assumptions for the marginal source for the two versions of the EPS is provided in Table 5-1.)
Landfill	0.020	0.001	No waste sent directly to landfill in EPS 2017 (as was the case in EPS 2011). However there is a slight increase in the quantity of residues sent to landfill in comparison to EPS 2011, primarily due to changes in the modelling of non-household waste.
MBT	0.000	0.008	Reduction in contribution existing MBT technology makes to treating London's waste in 2030/1 for EPS 2017. It is assumed that this is replaced by advanced pre-treatment capacity. These facilities have a focus on recovering more recyclate than existing MBT technologies operating in the UK; residues are assumed to be sent to incineration (with CHP), thus resulting in an increase in incineration.
Rejects	0.001	0.005	Reduction in residues for EPS 2017, primarily due to changes in the modelling of non-household waste.
TOTALS	**-0.167**	**-0.238**	

version of the EPS. Alongside this, there has also been a decrease in the benefit from dry recycling, occurring as a result of changes in the composition of recycled materials.

Further information on changes to the emissions factors, the changes in the marginal source data, and on the composition of recyclables is provided in Appendix A.1.0.

The residual waste arisings figures presented in this report differ from those published by Defra, as a result of the following assumptions summarised in Table 4-4. The starting point for the comparison is the first column, which shows the tonnage data in the EPS. The second and third columns confirm adjustments made to the EPS tonnages required to make the EPS tonnages equivalent to that of the Defra statistics, which are presented in the fourth column.

Table 4-4: Comparison between EPS and Defra Residual Waste Datasets

	Tonnes Managed in EPS	EPS adjustment to MBT Outputs	Other Adjustments in EPS	Total Tonnes Managed – Defra statistics & EPS
Landfill	706.6k	45.1k[1]	-1.2k[2]	750.5k
Incineration w EfW	1528.1k	179.3k	0.1k[3]	1707.6k
Incineration w/o EfW	2.0k	17.3k	0.2k[3]	19.6k

Notes

1. Landfill in the EPS excludes landfill from MBT plants (as this is included within the MBT figures) – this information is included in the Defra statistics under landfill.
2. The EPS includes 0.6 thousand tonnes additional material sent to hazardous and inert landfill from residual MRFs not included in Defra statistics, and 0.6 thousand tonnes of rejects without identified destinations in WDF (assumed to be sent to landfill).
3. Tonnages managed by incineration in the EPS also exclude outputs from MBT to incineration. Small additional differences from DEFRA remain, resulting from differing assumptions on the onward destinations of rejected recyclate.

Expressed in terms of a reduction in tonnes of CO_2 eq. from London's waste management, the EPS targets represent - relative to a baseline impact of -171 thousand tonnes CO_2 eq. achieved in 2015/6 - further reductions of:

- 101,000 tonnes CO_2 eq. by 2021;
- 169,000 tonnes CO_2 eq. by 2025; and
- 535,000 tonnes CO_2 eq. by 2031.

In comparing these figures with the carbon savings previously presented for the CIF in Section 3.2, it is important to note that the savings for the CIF are calculated in respect of all of London's municipal waste sent to energy from waste facilities, whereas the EPS savings are calculated in respect of local authority collected waste only, but also consider waste sent via other treatment routes. As such, the two sets of emissions savings figures are not directly comparable.

However, performance against the EPS and the CIF are linked to the extent that achievement of the CIF target means that no further action would need to be taken within the EPS on residual waste, other than in the situation where performance of household waste or LAC commercial services was some distance behind the assumed level of performance set out in Table 4-1.

5.0 Economic and Practicality Assessment

Assessments undertaken by SLR in 2011 considered the costs and practicality of meeting the EPS and CIF.[23] These cost and practicality assessments therefore need to be re-considered in the light of the potential change in activities required as a result of this revised version of the EPS and CIF.

It is important to note that a significant part of the challenge is associated with the need to meet the 50% tonnage based LACW recycling target, which underpins the EPS. Arguably, assuming this target remained in place, much of this activity would be required even in the absence of the EPS, and as such the cost of such activity is therefore not necessarily a cost of the EPS *per se*, although it is recognised that these policies are intended to be mutually supportive. Costs of meeting the recycling rate target include the following:

- In Resource London's household recycling rate scenario modelling, the cost of achieving the modelled recycling rate of 42.2% by 2025 (in comparison to business as usual) is estimated to be £129 million over the period 2018/9 to 2030/1. This includes an increase in annual operating and communications costs of £252 million including significant investment in recycling from flats, which is offset to a certain extent by the revenue from recycling of £190 million over the same period.
- The costs of operating the additional commercial waste services should be cost neutral to local authorities once the services have commenced operation and income covers operating costs. In some cases there may need to be some subsidy in the initial stages to kick start the operations, although this could also be reclaimed from the costs charged to customers.

[23] SLR (2011) Lifecycle Greenhouse Gas Performance for Municipal Waste Management Activities: Determining the Cost of Meeting the EPS and Carbon Intensity CIF, Final Report for GLA, June 2011

The additional capture of recyclables from residual waste is assumed to occur largely through the existing East London MBT contract being replaced by an advanced pre-treatment facility; in consequence, these costs would largely occur in the absence of the EPS.

As was shown in Section 4.0, we have assumed that both the 50% and 60% targets are met through an increase in the amount of commercial waste collected by local authorities. It is acknowledged that the required uplift in commercial waste operations by local authorities represents a significant practical challenge in respect of meeting the target.

It is noted, however, that if data systems improve, such that sufficient data on the performance of commercial waste collections operated through the private sector becomes available in the period out to 2030, the EPS would become easier to meet as the total amount of commercial waste available in London is higher than that modelled as being captured by the local authority collection systems.

It is understood that the EPS and CIF are key drivers in respect of moving London's EfW facilities towards the development of CHP infrastructure. As such, a key cost of meeting the EPS is that associated with the development of this infrastructure.

The required infrastructure for the Beddington site in South London was estimated by Viridor in 2012 to be £3.5 million.[24] These costs include the cost of the equipment in the CHP room, as well as the cost of the pipework to the periphery of the site. In this case, the estimate also covers the cost of connecting the associated landfill site to the network. Similar costs would be required to ensure all of the incineration facilities were CHP ready; costs may be less in some cases, as the need to include the connection of pipework to the landfill is specific to the Beddington site. It is noted that the costs of making EfW infrastructure CHP-ready should be accounted for in the project costs of any new facility given the permitting regime in place.

The development of the overall CHP system also involves a significant initial capital investment, covering, for example, the cost of developing the pipework connecting the district heating system to the heat users and associated infrastructure beyond the site of the incineration plant. Internal data from the GLA suggests up to 2.69 GW heat could be supplied annually through economically viable networks to which London's EfW facilities might contribute heat output.[25] The total cost involved in developing the necessary infrastructure to supply that heat to the users is estimated to be around £65 million.

However, these costs could be borne by the operator of the district heating network, working with the operators of London's incineration facilities, or through local authority waste contracts. The heat supplied to the network from EfW facilities is typically cheaper

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[24] Viridor (2012) South London Energy Recovery Facility – Combined Heat and Power Report, July 2012

[25] It is noted that the heat supplied by the LACW sent to London's incineration facilities in 2030 would account for around a quarter of the maximum potential figure, assuming the facilities operate in CHP mode at the efficiency assumptions incorporated in the forecast model

than that of other heat sources. Over time, the initial investment costs borne by the operators could be recouped once the network is in place from the sale of heat to the users.

There has also been some discussion in recent months regarding the potential introduction of a nationwide deposit refund system (DRS) in the UK on plastic bottles to help tackle marine litter. Evidence suggests that the capture of plastic bottles is increased through the introduction of these schemes; our analysis undertaken for Zero Waste Scotland suggested that provided a reasonable deposit is in place (e.g. around 20 pence per bottle) captures of in excess of 90 % of plastic bottles for recycling are possible, whereas in the absence of such a scheme household capture rates for this material are unlikely to exceed 50%. These schemes will not be run by local authorities. However, assuming the necessary data can be made available to measure the performance such that this can be incorporated within the EPS, the introduction of the DRS would be expected to improve captures of plastic waste, thereby making it easier to for London meet both the CIF and the EPS targets.

APPENDICES

A.1.0 Assumptions for Emissions Factors

Assumptions in respect of the carbon intensity of the marginal source of electricity generation for the target years are shown in **Table 5-1**.

Table 5-1: Assumptions for Marginal Source of Electricity

	2016	2020	2025	2030
CO_2 eq. / kWh	0.297	0.258	0.198	0.118
Notes: **The marginal source in the previous version of the EPS published in 2011 was 0.393 kg CO_2 / kWh electricity, in line with published guidance from Defra at the time the analysis was developed.**				

Key changes to the modelling of emissions factors are highlighted in Table 5-2 below, which also includes a summary of the impact of these changes on the calculations within the EPS forecast model.

Revised emissions factors are presented in Table 5-3, which also includes emissions factors not currently in use within the forecast model for 2030/1 (due to the treatment system not being anticipated to be used to treat residual waste in that year). Table 5-4 confirms the assumptions in respect of the carbon intensity of electricity generated at EfW facilities in 2030. Table 5-5 confirms assumptions made in respect of the recycling rate for key materials at the higher performance pre-treatment facilities. Finally, Table 5-6 provides data on the composition of key materials recycled in the two versions of the EPS.

Table 5-2: Updates to the Modelling of Emissions Factors

EPS element	Methodology update	Impact on 2030/1 target calculations
Recycling	Use of data on recycling benefits from the Scottish Carbon Metric as opposed to WRATE data, as these are more recent data and therefore considered to be more representative.[26]	Only a minor impact (representing a slight increase in benefit) on overall CO_2 eq. values results from this change, due to changes offsetting one another. For example benefits from recycling card and wood increase (per tonne), but benefit from recycling textiles, aluminium and some plastics decrease. Benefits from recycling WEEE are now included.
Organics	Update of LCA models in respect of carbon intensity of marginal source of electricity generation. Update of methodology to account for beneficial use of compost and digest. Other assumptions remain the same as WRATE models.	Very little change (updates offset one another)
Re-use	Benefits modelled using data from WRAP as these values were not available in WRATE.[27]	Additional small benefit - not in original scope
Incineration	Update of LCA models in respect of carbon intensity of marginal source of electricity generation. Update in energy efficiency of facilities operating in CHP mode. Other assumptions remain the same as WRATE models.	Increase in value due to impact of update in marginal source of electricity generation
MBT	Update to incineration assumptions as set out above (as residues are assumed to be sent for incineration).	No impact

[26] Data is available from http://www.zerowastescotland.org.uk/our-work/carbon-metric
[27] WRAP (2011) Benefits of Reuse Case Studies

EPS element	Methodology update	Impact on 2030/1 target calculations
Landfill	The life cycle methodology typically ignores all biogenic CO_2 emissions. Biogenic CO_2 emission are CO_2 emissions occurring from the treatment of organic materials such as food waste and paper. These are assumed (in carbon inventory accounting) to be cancelled out as a result of recent plant growth which has involved the sequestration of carbon from the atmosphere. However, this is problematic when accounting for landfill impacts, as a significant proportion of the biogenic carbon is not released as biogenic CO_2 (or methane) but instead remains sequestered in the landfill. In contrast, for thermal treatments, all biogenic carbon is released in the form of biogenic CO_2, but these emissions were ignored in the analysis informing the LCA methodology used in setting the current EPS. As such, if no adjustment is made, the exclusion of the biogenic CO_2 emissions will overestimate landfill impacts relative to other forms of treatment where all of the biogenic carbon is released as CO_2 into the atmosphere. As such, our landfill model includes a sequestration credit to account for the un-emitted biogenic carbon in landfill that would otherwise be emitted as biogenic CO_2, in line with the approach set out by Gentil et al (2009).[28] Reduction in the capture of landfill gas from 75% to 60%, in line with the central assumptions used in modelling work undertaken by Defra in 2014.[29]	Relatively little change (various updates offset one another)
Gasification	Reduction in energy generation performance in line with more recent data on the performance of these systems. Update of LCA models in respect of carbon intensity of marginal source of electricity generation. Other assumptions remain the same as WRATE models.	None (treatment system not currently modelled in EPS forecast model for 2030 as it is unclear whether such facilities will be built (and if so, to what configuration)

[28] Christensen, T., Gentil, E., Boldrin, A., Larsen, A., Weidema, B. and Hauschild, M. (2009) C balance, Carbon Dioxide Emissions and Global Warming Potentials in LCA-modelling of Waste Management Systems, Waste Management & Research, 27, pp707-717

[29] Defra (2014) Energy Recovery for Residual Waste – A Carbon Based Modelling Approach, February 2014

Table 5-3: Revised Emissions Factors

EPS element	Material / treatment system	Carbon impacts, tonnes CO_2 eq. / tonne of waste
Recycling	Paper and card	-0.34
	Plastic	-1.17
	Glass	-0.20
	Steel	-1.83
	Aluminium	-8.70
	Textiles	-5.99
	WEEE	-0.18
Composting / AD (2030 impacts)	Windrow composting	-0.05
	In-vessel composting	-0.03
	Anaerobic digestion[1]	-0.14
	Anaerobic digestion – output to fuel cell (elec. only)[2]	-0.16
Re-use	Textiles	-5.99
	Furniture	-0.22
	WEEE	-3.26
Residual (2030 impacts)	Incineration - elec. only	0.31
	Incineration - CHP	0.21
	MBT (biodrying)	0.20
	Landfill	0.20
	High performance pre-treatment / incineration (CHP)	0.08
	Gasification, steam turbine - elec. only	0.31
	Gasification, steam turbine - CHP	0.21
	Gasification, gas engine - elec. only	0.29
	Gasification, gas engine - CHP	0.08
	Incineration, output boosted with CCGT – elec. only	0.28
Food waste (2030 impacts)	Incineration - elec. only	-0.01
	Landfill	0.34

Notes

1. Assumes 25% AD with CHP, and 25% with biogas upgraded producing transport fuel.
2. In the short to medium term, upgraded bio-gas is anticipated to be the most likely route through which hydrogen will be produced through the waste management system

Table 5-4: Carbon Intensity of Key Energy from Waste Facilities (2030)

Technology	Carbon intensity of energy generation g CO_2 / kWh electricity
Incineration (CHP)	353
Incineration (electricity only)	604
Pre-treatment / incineration (CHP)	259
AD (electricity)	-198

Table 5-5: Recycling from High Performance Pre-treatment Plant

Material	Recycling rate
Paper	50%
Card	20%
Dense Plastics	50%
Plastic film	50%
Non combustibles	95%
Glass	90%
Ferrous metals	70%
Non-ferrous metals	45%

Notes

Pre-treatment facilities are used to extract additional recyclables from residual waste, prior to the residues being sent to residual treatment (assumed to be high performance incineration by 2030/1 in the EPS).

Table 5-6: Composition of Dry Recycling 2030/1

	EPS 2017	EPS 2011
Paper / Card	40%	61%
Glass	16%	17%
Ferrous Metals	4%	7%
Non-Ferrous Metals	2%	3%
Plastics	12%	7%
Textiles	1%	2%
Wood	6%	4%
WEEE	2%	
Other[1]	18%	1%

Notes

1. The ‘Other’ category captures any materials not part of the above material groups. Most of this tonnage in 2015/16 is rubble; other materials with significant tonnage in this category are plasterboard, furniture, mattresses, and material categorised as ‘other materials’ in WDF.