Deadline 3: Applicant's Response to the Examining Authority's Further Written Questions (ExQ1A)

Appendix 1.32 – Tolvik Review 2017 – UK Residual Waste – 2030 Market Review

Wheelabrator Kemsley (K3 Generating Station) and Wheelabrator Kemsley North (WKN) Waste to Energy Facility Development Consent Order

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UK Residual Waste: 2030 Market Review

Final

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Written By:

TOLVIK CONSULTING

The Environmental Services Association has engaged Tolvik Consulting to undertake an independent review of third party reports and analysis relating to the Residual Waste market in the UK in order to:

- Identify areas of "**common ground**" between the different reports and analysis;
- Identify **differences in methodology** between the reports and, where possible, both identify the reasons for these differences and, critically, the impact of the differences upon the overall assessment of the market;
- Develop a set of forward looking **assumptions** to drive future projections of the market.

ABOUT THE ENVIRONMENTAL SERVICES ASSOCIATION

The Environmental Services Association ("ESA") is the trade association representing the UK's resource and waste management industry. ESA's work helps enable its members to turn Britain's waste into valuable resources whilst protecting the environment. ESA engages with all levels of government, regulators and the public to help deliver a more sustainable waste and resource management solution for the UK.

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Disclaimer

This review has been prepared by Tolvik Consulting Ltd on an independent basis using its knowledge of the current UK waste market and with reference inter alia to various published reports and studies and to its own in-house analysis. This knowledge has been built up over time and in the context of its prior work in the waste industry. This review has been prepared by Tolvik Consulting Ltd with all reasonable skill, care and diligence as applicable and Tolvik Consulting does not warrant the accuracy of information provided. Whilst all reasonable precautions have been taken to check the accuracy of information contained herein, Tolvik Consulting Ltd shall not be responsible for the consequences (whether direct or indirect) of any decisions arising from this review.

EXECUTIVE SUMMARY

- Tolvik has been commissioned by the ESA to undertake an independent review of third party reports and analysis relating to the Residual Waste market in the UK. The review follows the recent publication of a number of reports which suggest a potential "under-capacity" in the Residual Waste treatment market in 2030 of 10.4Mt through to an "over-capacity" of 9.5Mt.
- The basis upon which the six reviewed reports were prepared varies greatly, as does the purpose for which they were designed. There is therefore limited benefit in directly comparing the headline findings in each report. Instead, this review seeks to identify areas of common ground, differences in methodology and to use the reports to help develop a series of forward looking assumptions.
- The focus of the reports and this review is upon Residual Municipal Waste – being Residual Waste which can be treated alongside residual Household Waste. Estimates in the reports of the tonnage of Residual Waste in 2016, the baseline year for the analysis, range from 26.0Mt to 27.9Mt.
- Following an analysis of the detail underpinning the 2016 figures in the reports, the review has assumed a 2016 baseline of **27.1Mt** of Residual Waste in the UK with a margin of error of c. +/- 2.0Mt.
- Across the six reports the projected tonnage of Residual Waste in 2030 varies greatly, ranging from a low of 13.5Mt to a high of 31.7Mt. The variations between the projections are primarily a consequence of differences in the recycling rates assumed in 2030.
- A simplified Tonnage Model has been developed in support of this review based on six key assumptions. Where possible, the Tonnage Model has been used to replicate the projected Residual Waste tonnages in the reports in 2030 to within a 5% margin.
- In the absence of long term waste policy, particularly in England, the Tonnage Model has then been used to develop five scenarios. These range from a No Change scenario (in which recycling rates, as currently measured, do not rise) to a High Recycling scenario which assumes a 65% recycling rate for Household Waste and a 78% recycling rate for municipal-like C&I Waste.

Scenario	2030 UK Recycling Rate			2030 Residual Waste (Mt)
	Household Waste	Municipal C&I Waste	Combined	
No Change	44%	61%	52%	29.5
50% Household	50%	63%	57%	26.8
55% Household	55%	65%	60%	24.5
CE Target	60%	70%	65%	21.0
High Recycling	65%	78%	71%	17.3

Figure E1: UK 2030 Residual Waste Projections

- Using the analysis in the reports, the review then considers the capacity for the treatment of Residual Waste in 2030. It estimates capacity in the UK which is currently operational or in construction to total 16.6Mt - being 14.5Mt of dedicated EfW capacity, 1.3Mt of cement kiln/IED biomass capacity and 0.8Mt representing the net impact of Mechanical Biological Treatment.
- On this basis, it is projected that in 2030 in the No Change scenario there will be a "gap" in Residual Waste treatment capacity of **13.0Mt,** whilst in the High Recycling scenario, by 2030 Residual Waste treatment capacity is projected to be 16.6Mt - just **0.7Mt** short of the tonnage of Residual Waste. In this scenario, the construction of Additional EfW capacity in the UK would therefore result in over-capacity. In the 55% Household scenario the projected "gap" is **8.0Mt.**

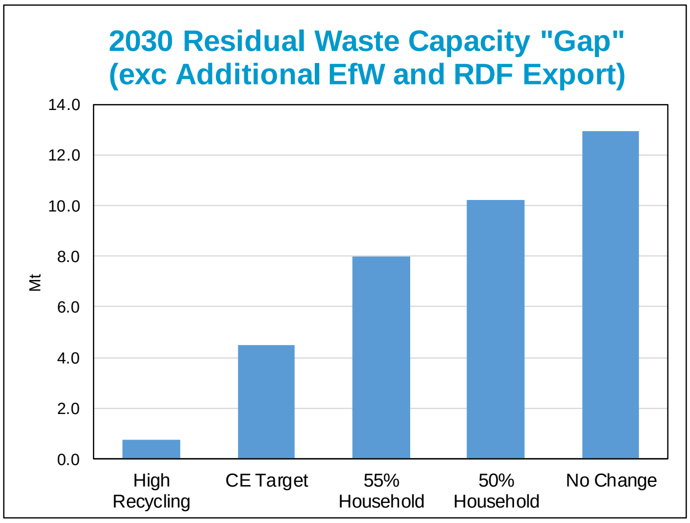


Figure E2: Projected UK 2030 Residual Waste Gap – excluding Additional EfW and RDF exports

- Five of the reports identify that, on the balance of probabilities, c.2.0Mtpa of Additional dedicated EfW capacity will also be constructed in the UK before 2022. When this is combined with a projected 2.5Mtpa of RDF exports in 2030 (the median figure from the estimates included in the reports), in the 55% Household scenario the 2030 capacity "gap" reduces to **3.5Mt.** In the High Recycling scenario the analysis suggests an overcapacity of **3.8Mt** whilst in the No Change scenario the "gap" would be as high as **8.4Mt**.

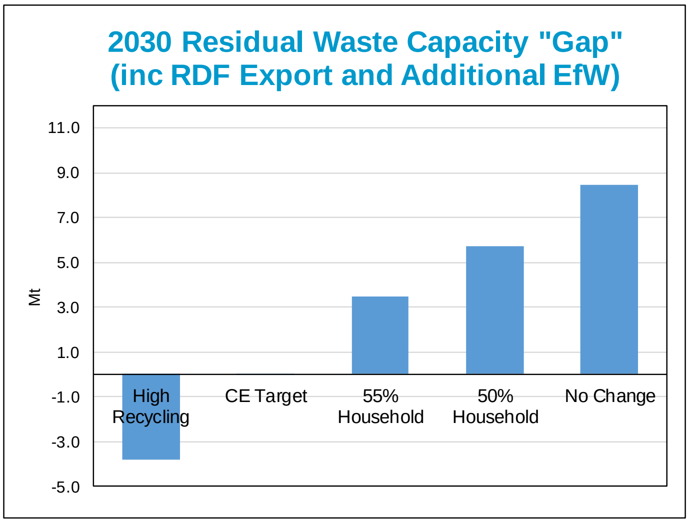


Figure E3: Projected UK 2030 Residual Waste Gap – including Additional EfW and RDF exports

- The modelling suggests that, notwithstanding the role landfill has to play in the future management of those wastes for which there is no alternative treatment, it will have a key role to play in providing the "balancing" capacity in the Residual Waste market through to 2030. For example, in the 55% Household scenario it is estimated that 69Mt of Residual Waste would need to be landfilled between 2018 and 2030.
- The review demonstrates the specific sensitivity of market projections to recycling assumptions. The current policy uncertainty, particularly for England, consequently increases the risk of a mismatch between Residual Waste tonnages and available treatment/disposal capacity. Such policy uncertainty may also serve to discourage capital investment into the sector, whether for infrastructure in support of recycling or for the treatment of Residual Waste.
- There are also a number of areas which were "out of scope" but which have the potential to impact on the findings of this review and which would benefit from further analysis/discussion.

1. INTRODUCTION AND BACKGROUND

1.1. Background

Reliable, good quality data is at the core of sound policy intervention and robust investment decisions. Over the last five years or so, there has been an ongoing public debate, informed by a number of published reports, as to the projected balance between the level of Residual Waste generated in the UK and the capacity, predominantly Energy from Waste ("EfW"), to treat it.

All parties would agree that this debate matters to the UK waste sector. Most (if not all) would probably agree that "overcapacity", such as that seen elsewhere in Europe, is neither environmentally nor economically beneficial.

The ESA has therefore engaged Tolvik Consulting to undertake an independent review of a range of third party reports and analysis relating to the Residual Waste market in the UK, not all of which are in the public domain.

The objectives of this review are to:

- Identify areas of "**common ground**" between the different reports and analysis;
- Identify **differences in methodology** between the reports and, where possible, both identify the reasons for these differences and, critically, the impact of the differences on the overall assessment of the market;
- Develop a series of forward looking **assumptions** to drive future projections of the market.

For the purposes of this review, Residual Waste is defined to be Residual "Municipal Waste" i.e. Household Waste and waste from other sources which is similar in nature and composition to Household Waste and so capable of being treated alongside Household Waste. This is considered more fully in Section 3.

It is hoped that by harnessing the range of available analysis this review will help to provide a better understanding of the factors influencing Residual Waste projections and, in turn, provide a clearer understanding of the potential effects of future policy on the Residual Waste market. The intention of the review is not to identify either "right" nor "wrong".

The scope of the review is deliberately narrow and focussed on the stated objectives. It does not consider, for example, the ability of the UK to achieve identified recycling rates nor the policy interventions which may be required if they are to be achieved. Section 7 identifies potential areas for further research arising from this review.

1.2. Independent Review

Those whose reports are referred to in this review have had the opportunity to check a pre-publication draft of this review. However, the analysis and conclusions of this review have been prepared solely by Tolvik on an independent basis.

Like many other consultants active in the UK waste and resources sector, Tolvik has itself previously undertaken a number of market assessments and/or participated in third party market analysis. Specifically:

- Author of UK Green Investment Bank's July 2014 report *"The UK Residual Waste Market";*
- Peer Review of Biffa's September 2015 report "*The Reality Gap*";
- Author of "*UK Thermal Treatment Market Review*" on behalf of FCCE as per Figure 1.

Whilst the review has sought to be as objective as possible, ultimately it will be for readers to draw their own conclusions as to the independence with which this review has been prepared.

1.3. Reports Reviewed

This review has analysed the most recent reports/information on the UK Residual Waste market listed by author in alphabetical order in Figure 1.

Each report was prepared for a specific purpose; this purpose may influence the way in which each report was compiled, the descriptions used for the scenarios within each report and the presentation of the findings. This review does not seek to replicate in full the analysis in each report.

Report	Date	Author	Link/Reference	Scenarios
The Reality Gap (2017)	Aug 2017	Biffa	https://www.biffa.co.uk/wp-content/uploads/2015/11/048944_BIFFA_Reality-Gap_2017Single-150817-2.pdf	Optimistic
				Realistic
				Pessimistic
Residual Waste Infrastructure Review Issue 12	July 2017	Eunomia	http://www.eunomia.co.uk/reports-tools/residual-waste-infrastructure-review-12th-issue/	Scenario 1
				Scenario 2
2017: UK Thermal Treatment Market Review	May 2017	FCCE	Tolvik analysis for FCCE prepared from the perspective of investment in EfW capacity	50% Recycling
				60% Recycling
				70% Recycling
Assessing the UK's Residual Waste Capacity Gap	Sep 2017	SLR	Invitation only presentation at RWM.	Business Case within a Residual Waste supply envelope
Mind the Gap 2017-2030	Sep 2017	Suez	http://www.sita.co.uk/wp-content/uploads/2017/09/MindTheGap20172030-1709-web.pdf	Single UK scenario but a wide range of regional level scenarios
Pennon: Full Year Results Roadshow	May 2017	Viridor	http://www.pennon-group.co.uk/system/files/uploads/financialdocs/pennon-full-year-results-1617-roadshow-final.pdf; additional confidential information provided in excel spreadsheet	Single GB scenario adjusted in the review for consistency to a UK wide scenario

Figure 1: Reports considered in this Review

A number of other, earlier published reports on the Residual Waste market have also been considered:

- DEFRA: Energy from Waste – A Guide to the debate – February 2013[i];
- Ricardo-AEA: CIWM Report 2013 – Commercial and Industrial Waste in the UK and Republic of Ireland[ii];
- Imperial College London: Waste Infrastructure Requirements for England – March 2014[iii];
- Green Investment Bank ("GIB"): The UK Residual Waste Market – July 2014[iv];
- DEFRA: Forecasting 2020 Waste Arisings and Treatment Capacity – October 2014[v];

As the data within each of these reports is relatively old, their empirical findings have not been incorporated into this review but consideration has been given to their methodology.

For ease of reading, in this review each report is referred to by author rather than by title; collectively they are referred to as "reports".

1.4. Report Headlines

All six reports listed in Figure 1 directly or indirectly draw conclusions with respect to the 2030 "gap" between the projected tonnage of Residual Waste in the UK and capacity available to treat it. In total there are 11 different projections considered in this review.

The basis upon which the different projections were prepared varies greatly. In particular, neither SLR nor Viridor include RDF exports in their calculation of the "gap". Their focus is upon UK capacity and both specifically note that the tonnage of RDF exported and the development of new EfW capacity in the UK are unlikely to be wholly independent of each other.

For consistency, the "headline" gap assessments in the reports have therefore been presented in this review in two ways; Figure 2 excludes RDF exports whilst RDF exports are included in Figure 3.

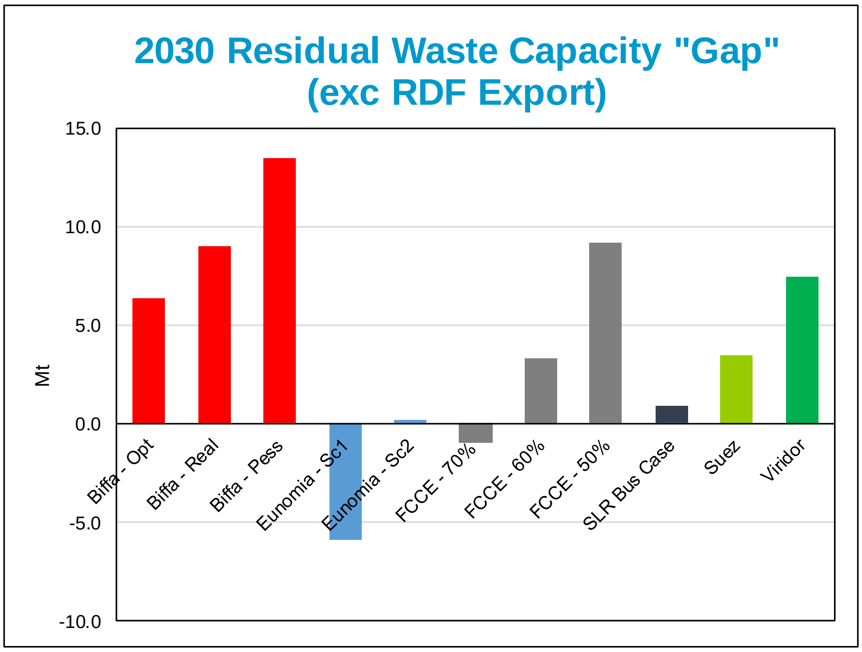


Figure 2: 2030 Residual Waste Capacity "Gap" excluding RDF exports Source: Reports

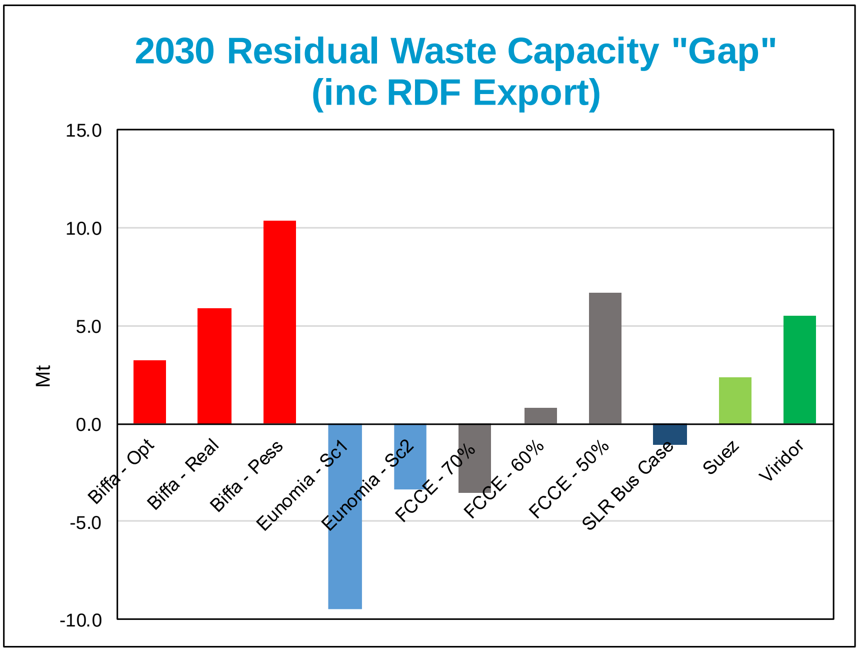


Figure 3: 2030 Residual Waste Capacity "Gap" including RDF exports Source: Reports

Under the different scenarios the reported 2030 “gap” ranges from an “under-capacity” of 10.4Mt to an “over-capacity” of 9.5Mt.

Given such a wide range of outcomes from the reports it is little wonder that there is some confusion as to the future of the sector amongst policy makers, investors and operators.

1.5. Acknowledgements

Tolvik is grateful to all those who have taken the time and effort to contribute to the preparation of this review, and in particular all the report authors who have been willing to share their data, assumptions and methodology and who have provided comments on earlier drafts of the review.

2. METHODOLOGY AND DATA

2.1. The Review Model

Given that each of the reports has its own calculation methodology, uses different assumptions and, most significantly, the purpose of each varies, it is therefore of little surprise that the headline findings, as demonstrated by Figures 2 and Figure 3, vary so greatly. There is therefore limited benefit in directly comparing the headline findings in each report.

Instead this review has used the reports to inform the development of a generic Tonnage Model. The Tonnage Model looks to maximise the use of data for which there is common ground between reports and, where data is uncertain, vary assumptions in order to assess their effect on the modelling.

Whilst there is a significant level of detailed analysis in some of the modelling underpinning the reports, the Tonnage Model has been deliberately simplified in order to generate projections of the UK Residual Waste market using only a limited number of assumptions.

A schematic detailing the development of the Tonnage Model is shown in Figure 4.

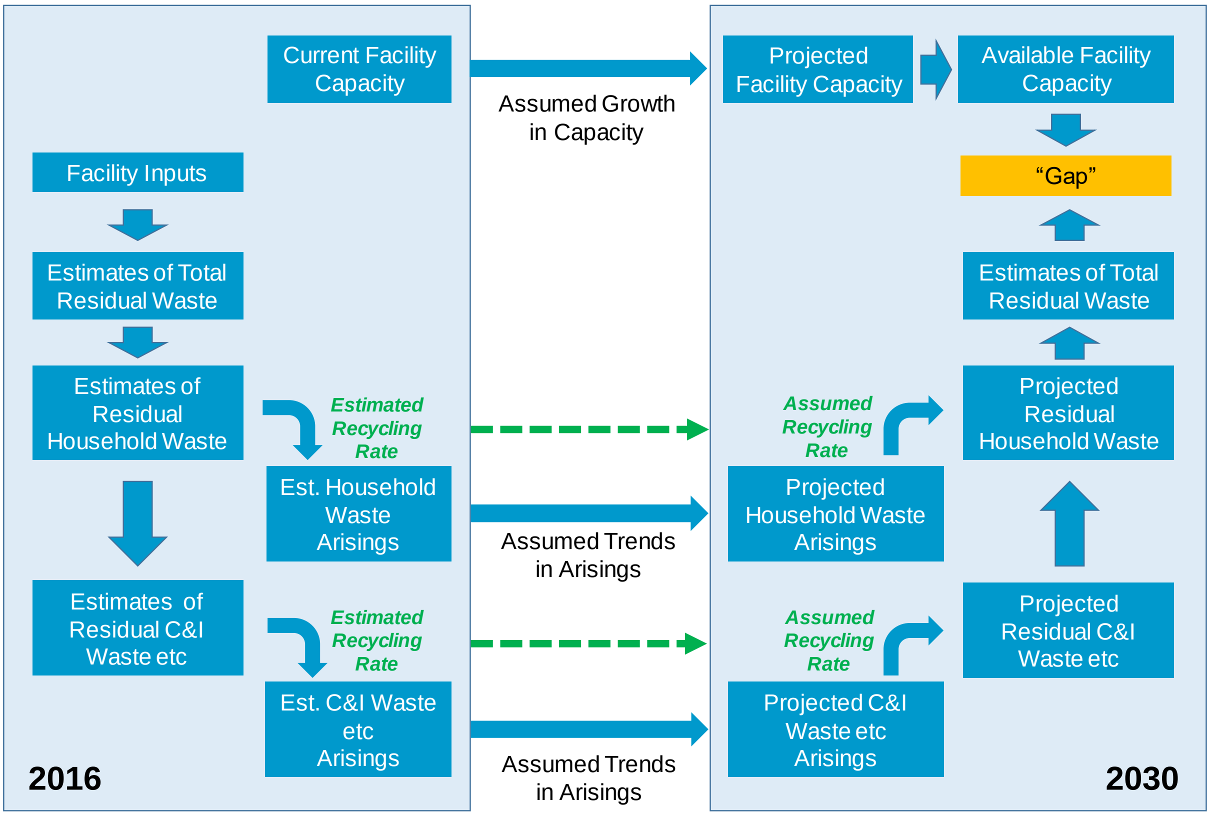


Figure 4: Review Model - Methodology

In creating the Tonnage Model it was necessary to identify a data set for a "baseline" year. For this review it is assumed to be 2016. Limited adjustments were therefore made to the analysis in Suez report for which 2017 is the first year.

From this baseline, the Tonnage Model was developed to project waste arisings, assess the impact of future recycling rates and treatment capacity under various assumptions to 2030. For simplicity, the Tonnage Model (and this review) focusses on 2030 with very limited analysis of individual years between 2016 and 2030.

The Tonnage Model was then tested against the projections in the report scenarios to establish its robustness and reliability.

2.2. Data Quality

It is widely acknowledged in many of the reports that data on Commercial and Industrial ("C&I") Waste is poor. Uncertainty has been further magnified by recent data releases by DEFRA which, as a result of changing methodologies, showed significant reductions in the reported level of C&I Waste arisings in the UK. It is understood that clarifying these issues remains an ongoing work stream for DEFRA and various consultees.

The limited availability of robust C&I Waste data has inevitably meant that the C&I Waste data in the reports is more heavily reliant on assumptions than is the case for Household Waste.

However, based on this review, whilst there are clear benefits from better data, it does not seem, at least at a national level, that the current lack of data on C&I Waste is a fundamental impediment to an analysis of the Residual Waste market. Indeed, notwithstanding a wide range of calculation methodologies, there is a reasonable degree of consistency between the estimates of current tonnages of Residual C&I Waste between the reports.

2.3. Miscellaneous Issues

The reports consider a mix of both calendar years and financial years. This review does not seek to differentiate between the two on the basis that the effect of such differences will be immaterial on 2030 projections. For simplicity, financial year 2016-17 is referred in this review as 2016.

Given the common use of the term "arisings" in relation to waste generation, this review refers to "tonnages of Residual Waste" rather than "Residual Waste arisings".

Unless otherwise stated, all tonnages are stated in Millions of tonnes ("Mt") to a single decimal place. The underlying excel model has been developed to 2 decimal places and so some data tables within the review may not appear to reconcile due to rounding.

Recycling rates are assumed to be measured on the basis currently adopted by the UK – i.e. excluding any recycling of Incinerator Bottom Ash.

The quality of the underlying data is such that it is reasonable to assume, unless otherwise stated, a margin of error in the analysis of at least +/-5% and potentially, for some data points, as much as +/-10%. Where there is a particularly significant level of data uncertainty this is identified within the text.

3. BASELINE TOTAL RESIDUAL WASTE

3.1. What is Residual Waste?

Figure 5 summarises the definitions of “Residual Waste” used in the reports.

Authors	Definition
Biffa	Municipal Solid Waste and municipal-like C&I Waste
Eunomia	The majority of residual waste ……. included in this analysis is material classed as non-hazardous Municipal Solid Waste (MSW), i.e. that which is left over after the separate collection of recyclables and biological treatment of segregated organic wastes, as well as that of a similar nature from commercial and industrial sources
FCCE	Solid, non-hazardous, combustible Residual Waste capable of being thermally processed alongside Household Waste. It covers the full spectrum from untreated ‘black bag’ waste through to Refuse Derived Fuel (“RDF”) and Solid Recovered Fuel (“SRF”)
Suez	Municipal waste is waste collected by local authorities, mainly waste from households. Separately added waste of an equivalent/similar composition from construction and demolition activities and from commercial/industrial premises
SLR	Mixed Residual LACW and C&I Waste
Viridor	Combustible Residual Waste suitable for processing in an EfW

Figure 5: Residual Waste definitions

Whilst the language used in the reports varies, there is a reasonably broad consensus and the principal focus is upon “Residual Municipal Waste” where the definition of Municipal Waste is:

“*Household Waste and that from other sources which is similar in nature and composition to Household Waste.*”

It is to be noted that this definition of Residual Waste excludes a wide range of non recyclable wastes which are not suitable for treatment alongside Household Waste. These include but are not limited to sludges, various low calorific value wastes, automotive shredder residues, hazardous wastes etc which are either subject to separate treatment and/or landfilled.

As Figure 6 shows, with the exception of Suez, the estimates in the reports of the tonnage of Residual Waste in the 2016 baseline year are remarkably similar, ranging between 26.0Mt and 27.9Mt.

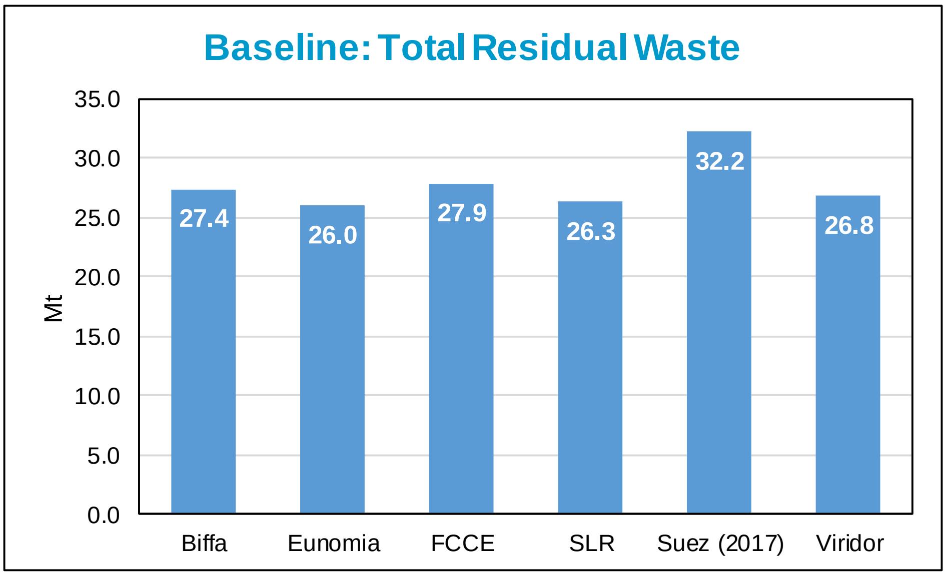


Figure 6: Baseline: Total Residual Waste   Source: Reports

The Suez figure differs from the other reports as a result of a combination of factors:

- A different methodology, particularly relating to the modelling of Residual Waste treatment solutions – including Mechanical Biological Treatment (see Section 3.6);
- Consideration of waste streams excluded from other reports – including incorrectly classified waste going to landfill and illegal activities (as discussed later in this section).

Suez have advised that their analysis, when using a similar methodology to the other reports, is circa 27.7Mt, i.e. falls within the range of the other reports.

There are nevertheless some variations in the definition of Residual Waste between the reports. Specifically:

- The inclusion or otherwise of non-municipal tonnages of Residual Local Authority Collected Waste ("LACW") – e.g. construction waste from Household Recycling Centres. Following a review of Wastedataflow it is estimated that these tonnages total no more than **0.4Mt** across the UK as a whole.
- C&I Wastes which are not similar in nature and composition to Household Waste but which are capable of being processed alongside Household Waste in an EfW – for example specific combustible reject streams from industrial processes. Following a review of landfill inputs in the Environment Agency's Waste Data Interrogator 2016[vi] it is estimated that this is likely to be no more than **0.5Mt** across the UK as a whole.
- Construction and Demolition ("C&D") wastes which can be processed in an EfW alongside Household Waste. This is a specific waste stream identified by Suez who estimate a maximum of 1.6% of total C&D tonnage – i.e. less than **1.0 Mt.**

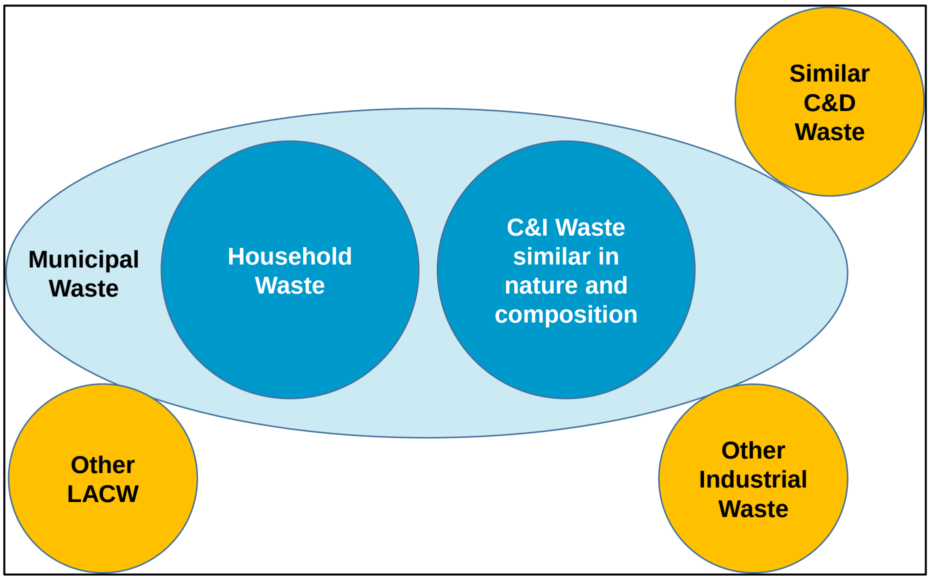


Figure 7: Defining Residual Waste

These factors may help to account for the differences between the reports.

It is noted that within the definition of Residual Waste all the reports include "black bag" waste, Refuse Derived Fuel ("RDF") and Solid Recovered Fuel ("SRF").

The absence of C&I Waste data means that in the reports the Residual Waste tonnages in Figure 6 were generally calculated using input data for waste treatment facilities.

To aid understanding, rather than simply taking the median of the data in Figure 6 as the "common ground" 2016 baseline, this review considers the 2016 input assumptions in more detail.

3.2. 2016 Facility Inputs: Dedicated EfW

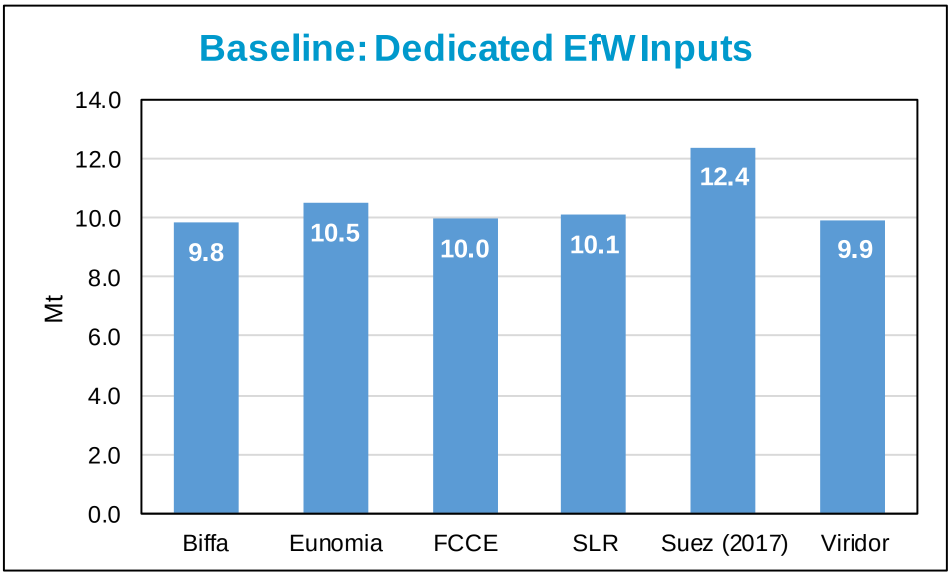


Figure 8: Residual Waste Inputs to Dedicated EfW Source: Reports

There is a reasonable degree of common ground between the reports in the assessment of tonnage of Residual Waste processed at dedicated EfWs in 2016. Tolvik's "*UK Energy from Waste Statistics – 2016*"[vii] identified 10.0Mt of inputs into 41 EfWs which processed Residual Waste in 2016. More recently released data has led to a modest revision to this figure to **10.1Mt**.

Suez's estimate relates to 2017. Due to the ongoing expansion in EfW capacity in the UK it is no surprise that their figure is higher than the estimates for 2016 in the other reports. Whilst the modelled figure is also greater than the projected level of EfW inputs in 2017 in other reports, any short term differences in the rate at which EfW capacity becomes operational is not material to an overall assessment of the market in 2030.

3.3. 2016 Facility Inputs: Co-Incineration

Where co-incineration has been considered in reports, the tonnage of Residual Waste sent to cement kilns and other co-incineration facilities in 2016 ranges between 0.1Mt and 0.5Mt. The latest publicly available data (Appendix 1) would seem to suggest a figure of around **0.4Mt**.

The figure used in the Eunomia report is materially higher in that it represents the capacity which is "*potentially available*" to accept Residual Waste rather than the tonnage of Residual Waste which was processed during the year. This highlights a difference in methodology between Eunomia and other reports; for the 2016 baseline Eunomia assesses the potentially available capacity at treatment facilities and the balancing figure is ascribed to landfill – which does not strictly reflect actual landfill inputs (see Section 3.6).

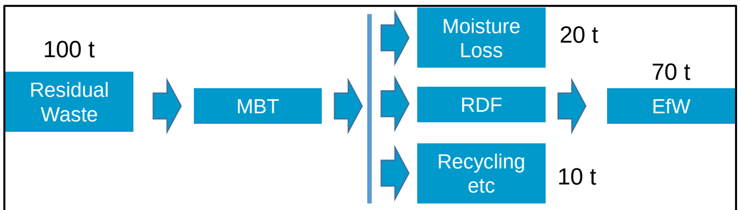
It is understood that in 2016 at least one Industrial Emissions Directive ("IED") compliant biomass facility ran a trial processing a modest tonnage of RDF alongside waste wood whilst ensuring that the overall biomass content remained above 90%. As for co-incineration, Eunomia considered the 2016 capacity at IED biomass facilities potentially available to accept Residual Waste rather than the tonnage of Residual Waste processed during 2016.

3.4. 2016 Facility Inputs: Mechanical Biological Treatment and Mechanical Treatment

Whilst the approach to modelling the impact of Mechanical Biological Treatment ("MBT") facilities on the overall Residual Waste market varies greatly between the reports, all reports recognise the risks of "double counting" – for example including both the tonnage of Residual Waste entering an MBT and the tonnage of RDF leaving an MBT and sent for thermal treatment.

By way of an example, Biffa and SLR modelling assumes that MBT facilities reduce input Residual Waste by 30%. Suez's methodology includes the MBT inputs in full and then, on a facility by facility basis, "adds back" the RDF produced to the Residual Waste tonnages. The effect is that whilst the calculated treatment capacity is apparently higher, so too is the corresponding Residual Waste tonnage. This different methodology has no net impact on the overall "gap" assessment, but it contributes in part to Suez's higher estimates of Residual Waste seen in Section 3.

The impact of these differing methodologies are illustrated in Figure 9.



	Suez	Biffa
Supply	170	100
Capacity – MBT	100	30
Capacity – EfW	70	70
Capacity – Total	170	100
Balance	-	-

Figure 9: Modelling the impact of MBT   Sources: Biffa, Suez

In their modelling, Eunomia adopt a range of assumptions depending on whether or not the MBT is co-located with an EfW. Where it is co-located, the capacity of the MBT is taken in full (and the EfW capacity ignored); where the MBT is standalone, it is assumed that 40% of capacity is removed for material and moisture losses during pre-treatment.

The FCCE modelling is similar to Eunomia, but on the assumption that 20% of the loss is moisture and the remaining reduction is included in future recycling figures. Viridor exclude the impact of MBT from their analysis due to the lack of quality data relating to the performance of third party facilities.

A recent analysis of the UK MBT sector[viii] by Tolvik suggests that on average moisture loss is 20% and "recycling" at UK MBT facilities ranges between 1% and 18%. This is perhaps lower than previous estimates as MBT operators are generally limiting residence time during the biological stage so as to manage the calorific value of the output and only recycling materials for which there is an end market are being extracted.

On this basis, irrespective of the modelling methodology, a 30% reduction appears to be a reasonable median assumption with a sensitivity of +/-10%. In 2016 total MBT inputs in the UK are estimated to have been around 2.6Mt; the corresponding modelled "effect" of MBT on the Residual Waste market in 2016 is therefore estimated to have been c. **0.8Mt.**

3.5. 2016 Facility Inputs: RDF Exports

As shown in Figure 10 and 11 it is estimated that in 2016 the total RDF exports from the UK as a whole were around 3.6Mt. Biffa have confirmed that their report utilises 2015 data.

Whilst provisional data on the tonnage of RDF exported from England is reported on a monthly basis, data from the devolved authorities is released on a less regular basis. There are also some differences between provisional data and final data (in 2016 this was 0.1Mt) and a consultancy, Monksleigh[ix], has in the past highlighted the potential impact of the difference between the date RDF is shipped from the UK and the date on which it is processed at an EfW. Whilst the differences between the two calculation methodologies are generally no more than 0.2Mt and so it is not material to the overall analysis, it is nevertheless a further source of data sensitivity.

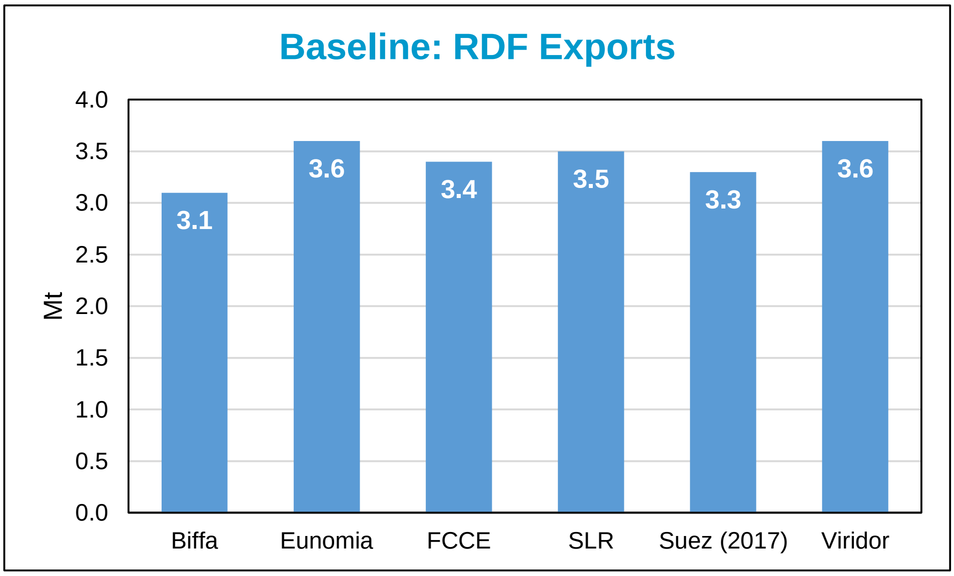


Figure 10: RDF Exports   Sources: Reports

	Data Source	2016 ktpa
England	*Eunomia FoI request to EA*	3,353
Wales	*Estimated*	c.50
Scotland	*SEPA FoI - Mid June 2016*[x]	c.70
N Ireland	*NIEA*[xi]	143
Total RDF Export		**3,616**

Figure 11: Estimates of RDF Exports   Sources: As shown

3.6. 2016 Facility Inputs: Landfill

3.6.1. The Reports

Figure 12 shows the estimated tonnages of Residual Waste (as defined in this review) to landfill in 2016. These vary in the reports (recognising, as discussed in Section 3.3, the different Eunomia methodology) between 8.9Mt and 13.6Mt. The tonnage of all waste sent to landfill in the UK was significantly higher, with 44.7Mt being sent to landfill in England alone in 2016[xii].

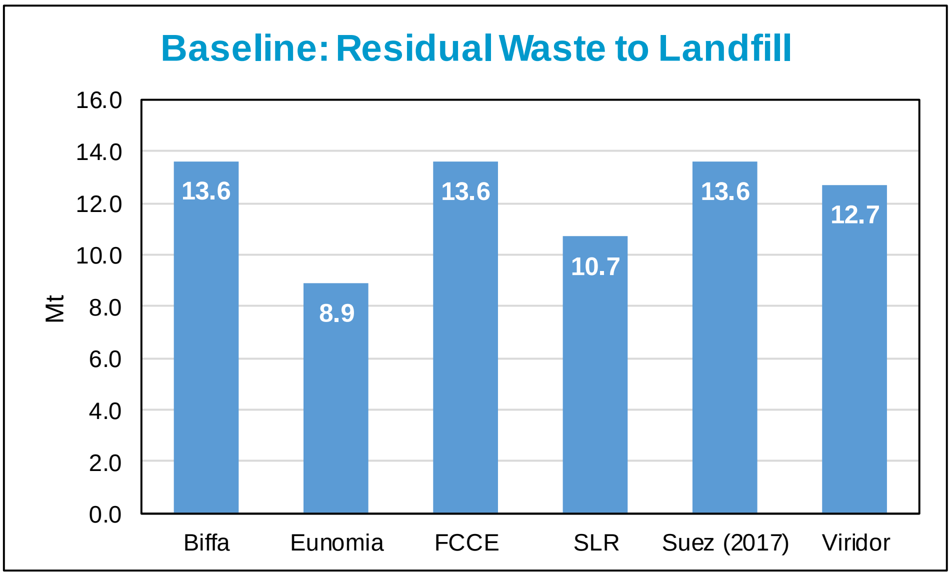


Figure 12: Residual Waste to Landfill   Source: Reports (NB Viridor adjusted for N Ireland)

In theory it should be relatively easy to assess the tonnage of Residual Waste sent to landfill in 2016. However, it is widely acknowledged that there are significant differences in the tonnages reported by operators in their quarterly site returns to the regulators (EA, SEPA, NRW and NIEA), DEFRA assessments of Municipal Residual Waste sent to landfill (as part of its reporting requirements under the EU Landfill Directive) and the combined landfill tax data from HMRC and Revenue Scotland.

In 2015 (at the time of this review, the last year for which data is fully available) the variation between assessments based on the different data sources was c.4.9Mt (ranging from 10.4Mt to 15.3Mt).

Basis for Estimate	Household, Commercial and Industrial ("HIC")	Municipal Residual Waste	All Standard Rate Landfill Tax (All)	Standard Rate Landfill Tax (exc Hazardous)	Standard Rate – Municipal Waste only
Ref	A	B	C	D	E
Source/ Calculation	*Estimated from England + Scotland EA/SEPA data*	*DEFRA Landfill Directive Return*	*HMRC/ Revenue Scotland*	*C – Hazardous Tonnages*	*D x B/A*
2014	20.7	**18.2**	15.5	14.6	**12.8**
2015	18.6	**15.3**	13.7	12.7	**10.4**
2016	17.8	***15.0 (est)***	12.1	11.3	**9.2**

Figure 13: Estimates of Residual Waste to landfill Sources: As shown

Landfill Tax data provides the lowest figure and there is little doubt that this sets an absolute "floor" to potential tonnages of Residual Waste sent to landfill. This is estimated in Figure 13 to be circa 9.2Mt. This is broadly consistent with Eunomia's analysis:

"The UK landfilled around 11 million tonnes of waste at the standard rate of landfill tax last year, but probably no more than nine million tonnes would be suitable or available for treatment by incineration."

However, HMRC have estimated[xiii] in 2014-15 that for landfill tax there was a "tax gap" of 12% - suggesting that landfill tax potentially under-estimates the tonnages of Residual Waste to landfill. 360 Environmental[xiv] have noted that in 2016 there is some evidence to suggest that the gap had widened. Assuming for simplicity that the 12% avoidance applied equally across all tax bands, then it could be argued that the "floor" in Figure 13 of 9.2Mt for 2016 would rise to **10.5Mt**.

The issue can also be considered on a "top down" basis. DEFRA reported that in 2015 15.3Mt of (Residual) Municipal Waste was landfilled. However, this potentially over-estimates the tonnage of Municipal Waste to landfill.

Separate analysis of publicly available data suggests that (with the probable exception of Scotland), the DEFRA figure includes all waste to landfill coded under the European Waste Catalogue as 19 12 12. In fact, a review of waste treatment facilities in England producing 19 12 12 reveals that this code is being used for a range of different outputs, some of which are almost certainly inert and fall within the lower landfill tax band (and so not suitable for treatment alongside Household Waste). Analysis of all sites in England would suggest that at least 65% of 19 12 12 was derived from active waste inputs. Further analysis is contained in Appendix 1.

Across the UK as a whole in 2016 it is estimated that around 8.8Mt of 19 12 12 was produced and sent to landfill of which it is therefore estimated circa 2.8Mt was inert-derived. This would suggest that the total tonnage of Residual Waste sent to landfill in 2016 was 15.3Mt less 2.8Mt, i.e. **12.2Mt.** If instead it is assumed that c.80% of 19 12 12 was active waste, then the total tonnage of Residual Waste to landfill in 2016 is estimated to have been **13.6Mt**.

On balance this review assumes a figure of 12.2Mt.

3.7. Exempt Sites/Illegal Activity

Aside from the uncertainties surrounding the classification of Residual Waste at permitted landfill sites (see Section 3.3), it is likely that a portion of Residual Waste is also "lost" from official statistics through being incorrectly directed to exempt sites and through illegal waste tipping.

Assessments by the ESA[xv] suggest that as at June 2016 at least 1.6Mt of waste had been accepted at known illegal sites in England alone and that waste crime as a whole had an economic cost of £600m in 2015. ESA's view is that as the number of landfill sites reduce, so the scope for "low risk" crime (e.g. miscoding wastes) will reduce and this will have a knock-on impact to the sector more generally.

The question then is whether or not estimates of such activities should be included in the overall assessment of the Residual Waste market. This review has concluded that whilst better regulation/enforcement of such activities is likely to have an impact on the tonnage of Residual Waste available for treatment, as the effect probably lies within the overall margins of error, so a specific figure has not been separately identified.

3.8. Baseline Total Residual Waste

Based on the analysis above, for the purpose of this review, the baseline Residual Waste tonnage in 2016 is therefore assumed to be **27.1Mt** with an estimated error of margin of +/- 2.0Mt (7.0%).

Mt	Median	Range Down	Range Up
Landfill	12.2	(1.7)	1.3
Dedicated EfW	10.1	(0.1)	0.2
MBT Impact	0.8	(0.2)	0.3
IED Biomass	0.0	0.0	0.0
Co-Incineration/Cement Kilns	0.4	(0.1)	0.1
RDF Export	3.6	(0.2)	0.0
Total	**27.1**	**(2.3)**	**1.9**

Figure 14: Residual Waste Baseline Inputs

Figure 15 shows this estimate set against the reports, including the Suez's internal estimate of the tonnage of Residual Waste using a similar methodology to those in the other reports.

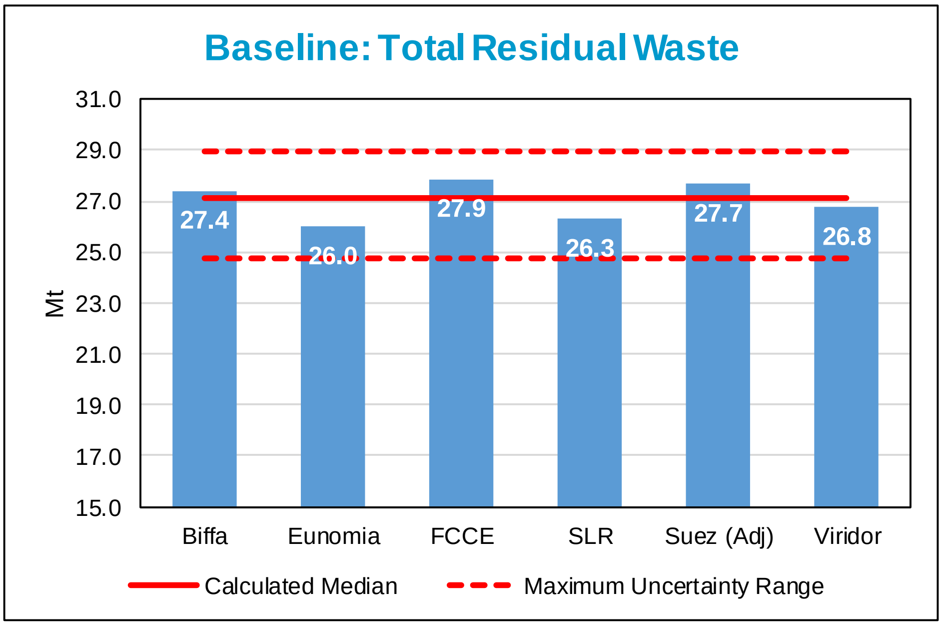


Figure 15: Median Baseline Residual Waste compared to reports

4. RESIDUAL WASTE PROJECTIONS

4.1. The Reports

Figure 16 shows the Residual Waste projections to 2030 under the 11 different scenarios.

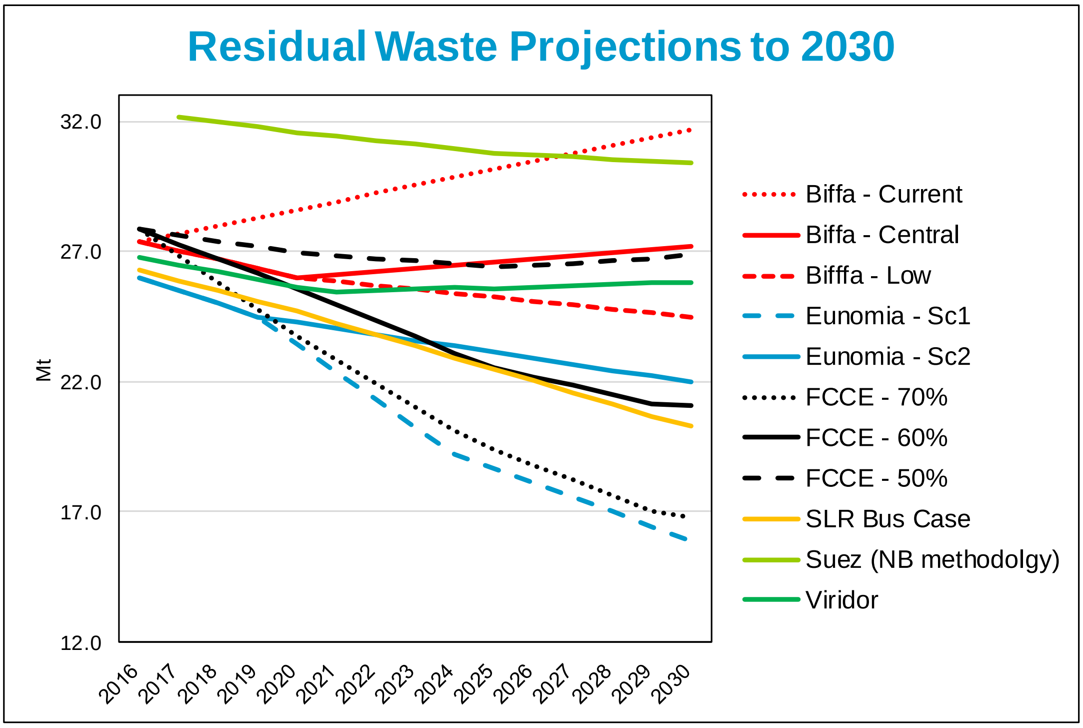


Figure 16: Residual Waste Projections Sources: Reports

Whilst the 2016 baseline Residual Waste tonnages vary relatively modestly, the effect of the differing assumptions underpinning the scenarios in the reports is significant. By 2030 the projected tonnage of Residual Waste ranges from a low of 15.9Mt to a high of 31.7Mt.

It is worth noting that not all of the scenarios within the reports are necessarily regarded by report authors as a likely outcome; some scenarios have been developed specifically to illustrate the effects of changing assumptions and/or for the purpose of sensitivity testing.

4.2. Projecting Residual Waste

Whilst the methodology and level of complexity underpinning the reports varies greatly, there are a number of key assumptions necessary to develop projections of future tonnages of Residual Waste.

Using these key assumptions as inputs into the Tonnage Model, it was possible to "validate" the Tonnage Model by comparing its 2030 projections with the Residual Waste projections in the reports.

Where such validation was possible, the variances between the 2030 projections in the Tonnage Model and the reports were within +/5%; well within the more general margin of error. It was therefore concluded that the Tonnage Model was sufficiently robust to be used in support of this review.

4.3. External Data Used in the Tonnage Model

The only external data used in developing the Tonnage Model were:

- Office of National Statistics ("ONS") Population projections[xvi];
- Household Waste data for 2015/16 (DEFRA, StatsWales, NIEA) and 2015 (Scotland) (as per Appendix 1). Note that a better approximation to the outputs in the reports was achieved using the definition of Household Waste rather than the alternative "Waste

from Households" in the Tonnage Model. This suggests for 2016 an assumed 28.2Mt of Household Waste arisings with an average recycling rate of 43.8%.

All other data was generated using assumptions stated in the reports or their associated models.

4.4. Household Waste Assumptions

4.4.1. Projected Household Waste Arisings Growth

Figure 17 sets out, where available in the reports, the assumed annual average growth in Household Waste arisings. Whilst these are set out in Figure 17 for the UK as a whole, in most reports the actual analysis was for each of the devolved regions. Most reports consider the differences in waste generation rates on a per capita or per household basis and account, to a lesser or greater extent, for the effects of "resource efficiency".

The reports generally identify that, notwithstanding any effects of resource efficiency, the pressure of increased population (projected by the ONS to grow by 0.5% per annum across the UK as a whole by 2030) will result in a rise in Household Waste arisings.

Report	Net Annual Growth – High	Net Annual Growth - Low
Biffa	0.7%	
Eunomia	0.5%	
FCCE	0.9%	(0.1)%
SLR	0.6%	
Suez	0.6%	
Viridor	0.3%	
Median	**0.5%**	

Figure 17: Net Assumed Annual Growth in Household Waste Source: Reports

4.4.2. Projected Household Waste Recycling Rate

All the reports note that, following the Brexit vote, there is much less clarity on future recycling policy. The 50% recycling target for Household Waste by 2020 set within the Waste Framework Directive is currently the only UK-wide target.

The UK is also engaged in discussions with regards to the EU's Circular Economy Package, the timing of which is running in parallel with Brexit, although as Eunomia notes, the Circular Economy package is not something about which DEFRA ministers have been "*wholly enthusiastic*".

However, the manner in which the reports address this uncertainty, particularly for England, varies greatly and the assumptions made regarding 2030 Household Waste recycling rates arguably have a greater impact on Residual Waste projections than any other.

Nearly all the reports recognise the different waste policy context in the devolved regions (Scotland, Wales and Northern Ireland) and adjust their assumed Household Waste recycling rates accordingly. However, given these regions account for just over 15% of total Household Waste arisings, such assumptions have only a very modest impact on the projections for the UK Residual Waste market as a whole.

Biffa note that with respect to recycling *"speculation beyond 2025 to 2030 can only be tentative at best and needs keeping under review".* Their report considers a range of recycling rates with the lower limit based on current recycling rates and the upper limits based on an assumed 65% Circular Economy target, less an assumed 5% contribution from the recycling of incinerator bottom ash. It is not within the scope of this review to consider the merits or otherwise of the inclusion of incinerator bottom ash in recycling figures. Biffa's "realistic" (central) scenario is based on 54% recycling, and uses European comparator information sourced from Tolvik.

Eunomia select the 2020 revised Waste Framework Directive target as the “low recycling” scenario and the current EU Circular Economy target of 65% for their “high recycling” target.

The FCCE analysis also has 50% as the low recycling scenario. Their high recycling scenario is an effective Household Waste rate of 63%; the actual modelling sets a 70% recycling target for individual local authorities but then applies a constraint at a local authority level to recycling rates based on current recycling performance – i.e. assumes that local authorities with low recycling rates will be unable to achieve 70% recycling.

Whilst Suez has a single national scenario as an output, more detailed modelling was undertaken at a regional level and under a range of scenarios reflecting the effect of various commercial factors on future levels of recycling. The net effect for the UK was a calculated weighted average Household Waste recycling rate for the UK as a whole of 56% by 2030. In its Business Case SLR uses an average 60% Household Waste recycling rate whilst Viridor’s assumptions result in an average recycling rate, after allowing for rejects, of around 50%.

Report	Low Recycling	Central Recycling	High Recycling
Biffa	44%	54%	60%
Eunomia	50%		65%
FCCE	50%	57%	63%
SLR		60%	
Suez		56%	
Viridor		50%	

Figure 18: Assumed 2030 Household Waste Recycling Rates   Source: Reports

4.5. C&I Waste Assumptions

4.5.1. Baseline C&I Waste Data

The unreliable nature of C&I Waste data means that the Tonnage Model uses the 2016 baseline Residual Waste tonnage (Section 3) and baseline Residual Household Waste tonnage (Section 4.3) to establish the tonnage of Residual C&I Waste.

Generally, where the reports have declared an assumed recycling rate it relates to “municipal-like” C&I Waste rather than all C&I Waste. Using these recycling rates to establish the equivalent figure for “municipal-like” C&I Waste arisings provides one way in which future trends in “municipal-like” C&I Waste can be modelled – and this is the approach used in the Tonnage Model.

However, it must be stressed that the C&I Waste arisings calculated in this way do not represent all C&I Waste arisings – rather that portion of the C&I Waste stream which gives rise to Residual Waste falling within the definition set out in Section 2.1.

Report	2016 Recycling	Comment
Biffa	59%	Reported for municipal-like C&I Waste
Eunomia	65%	Commercial: 63% Industrial: 67%
FCCE	62%	Calculated for municipal-like C&I Waste
SLR	N/A	Different methodology applied
Suez	56%	Reported for municipal-like C&I Waste
Viridor	47%	Calculated for municipal-like C&I Waste

Figure 19: 2016 C&I Waste Recycling Assumptions   Source: Reports

Given the uncertainty around data it is not surprising that there is some variation between reports. For example, Viridor assume a smaller tonnage of municipal-like C&I Waste than others but a correspondingly lower recycling rate resulting in a similar estimate of Residual C&I Waste in 2016. The Tonnage Model therefore adopted the median of the four assumptions (i.e. excluding Viridor) of an assumed 2016 recycling rate for municipal-like C&I Waste of 61%.

It should be noted that the absence of data values for SLR's assessment in Figure 19 reflects a different modelling methodology, in which SLR's approach, due to the inherent data uncertainties, is to focus specifically on projecting the Residual C&I Waste stream – as opposed to the totality of C&I Waste arisings combined with any assumed recycling rate.

4.5.2. Projected C&I Waste Arisings Growth

Figure 20 sets out, where applicable, the assumed annual growth rates for "municipal-like" C&I Waste arisings in the reports. The reports generally identify ongoing upward pressure on C&I Waste arisings; the only exception being Viridor which identifies a total decline in headline C&I Waste arisings but that there will be an increasing proportion of "municipal-like" C&I Waste which will generate Residual Waste so producing net growth.

It is noted that none of the reports model the impact of a significant recession on the Residual C&I Waste market.

Report	Net Annual Growth – High	Net Annual Growth - Low
Biffa	1.4%	1.4% to 2020 and 0.7% thereafter
Eunomia	0.5% for Commercial Waste; (1.0) % for Industrial Waste	
FCCE	1.2%	0.2%
SLR	Not Applicable	
Suez	0.8%	
Viridor	1.4%	
Median	**0.7%**	

Figure 20: Net Assumed Annual Growth in "municipal-like" C&I Waste Source: Reports

4.5.3. Projected C&I Waste Recycling Rate

The projected 2030 municipal-like C&I Waste Recycling Rates in the reports are set out in Figure 21.

Report	Low Recycling	Central Recycling	High Recycling
Biffa	59%	62%	62%
Eunomia	Commercial: 70% Industrial: 75%		Commercial: 75% Industrial: 80%
FCCE	70%	76%	80%
SLR	Not Applicable		
Suez		65%	
Viridor		55%	

Figure 21: Assumed 2030 "municipal-like" C&I Waste Recycling Rates Source: Reports

4.6. Scenarios using the Tonnage Model

It is beyond the scope of this review to consider the policy instruments required to deliver specific recycling targets and the constraints in their delivery (economic, social and technical). This is discussed further in Section 7.

Instead the Tonnage Model has been used to develop five projections of Residual Waste in 2030 under a range of key assumptions.

In developing such projections, one issue to consider is whether or not there is an inter-dependency between assumptions – particularly those relating to recycling and those to waste growth. In running "downside" scenarios for investors, projections will typically consider a "low growth, high recycling" scenario. However, none of the reports specifically highlighted a relationship and so this review has assumed that the variables are independent.

As assumptions of future recycling rates have the greatest impact on the projected tonnages of Residual Waste, so scenarios have been defined around recycling rates. By way of setting boundaries, Figure 22 includes a **No Change** scenario (in which recycling rates remain unchanged from 2016) and a **High Recycling** which is based on 65% recycling rate for Household Waste in 2030 and 77.5% for municipal-like C&I Waste.

The 55% Household scenario has been informed by the analysis of Household Waste recycling rates in Suez's "*At this rate…*"[xvii] alongside other reports produced by ESA members. The two other scenarios are based on the UK achieving an average 50% Household Waste recycling rate and the second where an overall 65% recycling rate is achieved (in effect the lower Circular Economy target).

Three scenarios use the same arising growth assumptions. By way of reference if the growth assumptions set out in Figure 22 were halved, then the projected 2030 Residual Waste would be reduced from that shown by 1.0 to 1.3Mt (equivalent to increasing the 2030 recycling rate by 2%).

The Circular Economy ("CE") and High Recycling scenarios assume that resource efficiency policy has an impact on waste arisings and so the assumed growth rates have been modelled 30% lower than those assumed in the other three scenarios.

Scenario	2030 UK Recycling Rate			Average Annual Growth		2030 Residual Waste (Mt)
	Household Waste	Municipal C&I Waste	Combined	Household	Municipal C&I Waste	
No Change	44%	61%	52%	0.5%	0.7%	29.5
50% Household	50%	63%	57%	0.5%	0.7%	26.8
55% Household	55%	65%	60%	0.5%	0.7%	24.5
CE Target	60%	70%	65%	0.4%	0.5%	21.0
High Recycling	65%	78%	71%	0.4%	0.5%	17.3

Figure 22: 2030 Residual Waste Scenarios Source: Tonnage Model

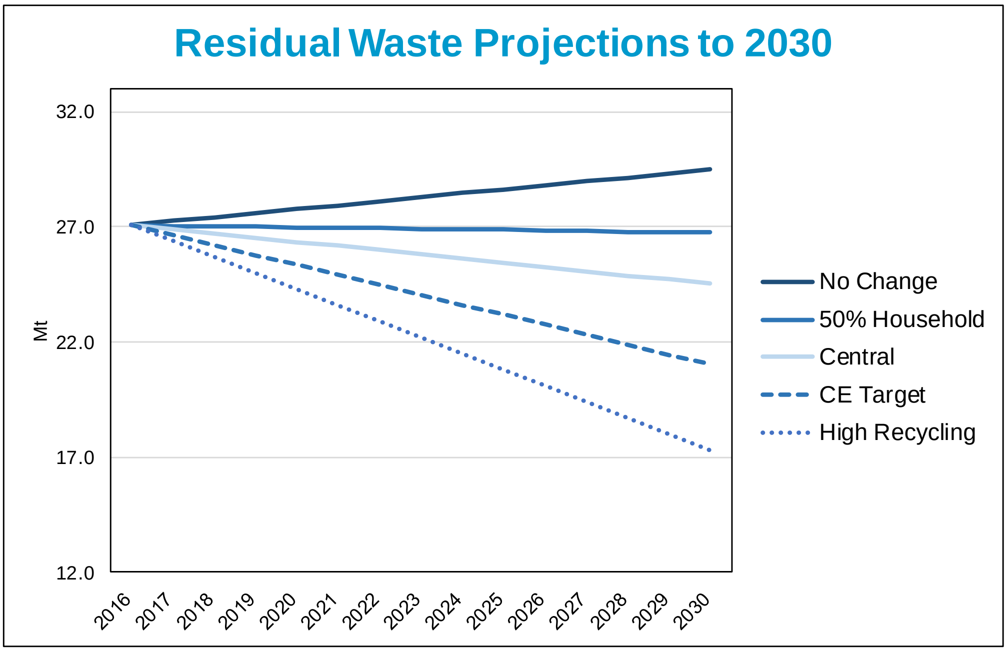


Figure 23: Tonnage Model Projections

5. 2030 RESIDUAL WASTE TREATMENT CAPACITY

5.1. Dedicated EfW

The capacity for the treatment of Residual Waste in dedicated EfWs in 2030 will be a function of:

- The capacity at "Certain" EfWs, where Certain EfWs are defined to be EfWs which, as at the date of this review, are operational, in construction or for which all finance and consents are in place and for which construction is imminent;
- Availability assumptions and future trends in the Calorific Value ("CV") of Residual Waste which impact on the tonnage of Residual Waste which can be processed at such facilities;
- "Additional" EfW capacity constructed after the date of this review;
- Any decommissioning activity which leads to a reduction in capacity.

5.1.1. Availability Assumptions

Historically EfWs have not operated at their maximum consented capacity. According to Tolvik's "*UK Energy from Waste Statistics – 2016*" EfWs operated at 92.7% of their maximum capacity and with a time based availability reported by EfW operators of 90.2%.

Reports have therefore made assumptions with respect to availability as shown in Figure 24.

Authors	**Assumed Availability**
Biffa	90% for all
Eunomia	95% for conventional, 75% for ACT
FCCE	Average of last full operational years (to max 5) or, where not available, 95%
SLR	Facility by facility assessment
Suez	Facility by facility assessment
Viridor	Facility by facility and overall 92%

Figure 24: Availability Assumptions for Dedicated EfW Source: Reports

It is noted that in recent years the capacity of several newer EfWs have been increased post commencement of operations with no change in plant design. These increases have arisen as a result of lower than expected CV, better than expected availability (through improved operating practices) and/or over-conservative guarantee parameters.

On the other hand, as Eunomia factor into their assessment, there remains the potential that some specific facilities will consistently operate at below expected levels.

5.1.2. Certain EfW

There is a reasonable degree of consistency between the reports with respect to the projected capacity at Certain dedicated EfWs in the UK – where the capacity is assessed after availability assumptions have been applied.

Note that as no new dedicated EfWs have reached financial close in 2017 all the reports derived their estimates from the same baseline. As Figure 25 shows, the estimates for total capacity in 2030 range between 13.8Mt and 15.3Mt, with the Eunomia figure lower than others due on the way in which capacity at co-located facilities is allocated to EfW and MBT.

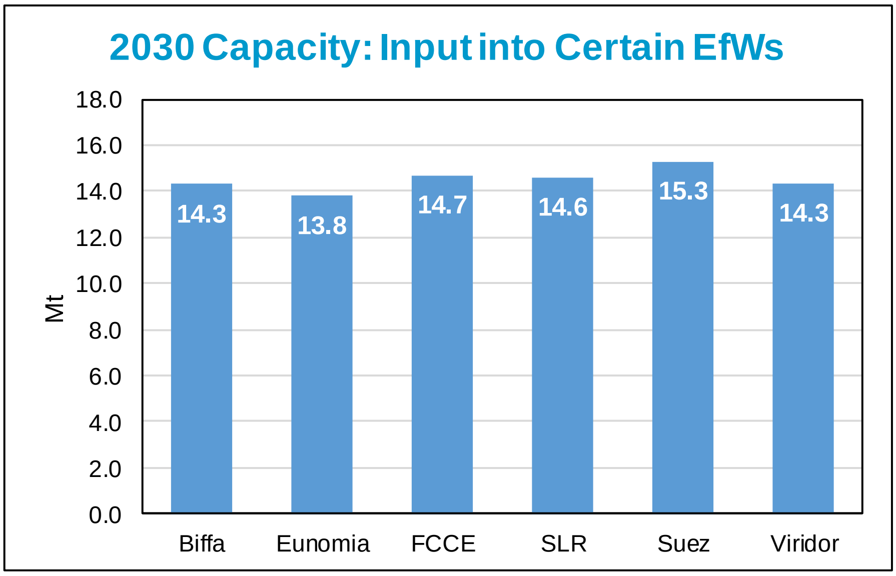


Figure 25: Projected inputs into Certain EfWs Source: Reports

5.1.3. Additional EfW Capacity

A number of the reports make assumptions regarding the likely development of Additional EfWs in the UK; generally such assessments are based on a probability assessment of all current current EfW development projects.

Eunomia makes no assumptions with regards to the development of Additional EfW capacity.

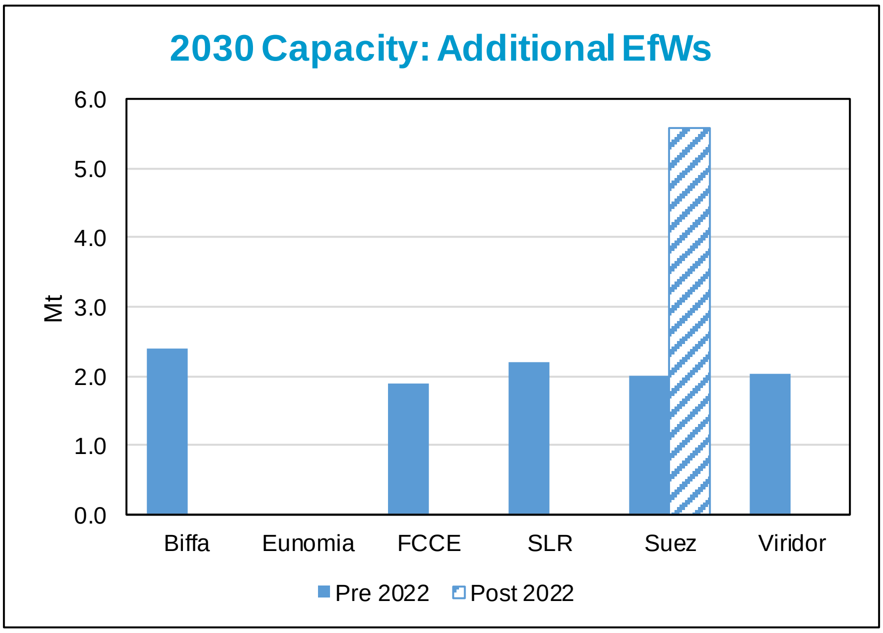


Figure 26: Likely Development of Additional EfW Capacity Source: Reports

The Suez report identifies potential Additional EfW capacity of 2.0Mt in the period 2017 – 2022 with a further 5.6Mt thereafter. The other reports focus on the near term development of Additional EfW and there is a reasonable congruence between reports in estimating that between 1.9 Mt and 2.4Mt of Additional EfW capacity is likely to be committed and constructed in the short to medium term.

Longer term, the expectation is that Additional EfW capacity will be dependent upon future waste policy and the investor risk appetite. In particular, as Residual Waste treatment capacity and supply move closer, so it would be reasonable to assume that the commercial case for an investment in an EfW becomes more challenging. There will be fewer potential Residual Waste suppliers. Those with the ability to supply are less likely to be able (and/or willing) to provide the necessary security third party investors have to date typically required.

In such circumstances one option would be for a more "merchant" model to be adopted. At present the investment community is generally uncomfortable with such an approach and to be "investible" such a model would almost certainly require a reasonable level of Residual Waste "cover" – being the tonnage of Residual Waste available within a specific catchment area divided by the EfW capacity.

Given this uncertainty, in this review the projections of the capacity "gap" in Section 6 are therefore calculated in two ways. First they are calculated excluding the effects of Additional EfW capacity and then calculated based on the consensus near term estimates of Additional EfW capacity.

5.1.4. Decommissioning

None of the reports model decommissioning of existing dedicated EfWs. In practice it is expected that some EfW decommissioning may take place but, as seen in Europe, where decommissioning does occur, existing capacity will at least be replaced with new – e.g. Edmonton.

5.2. Co-Incineration and IED Biomass

There is the potential for an expansion in the use of SRF at cement kilns, particular as operators seek to reduce their reliance on fossil fuels through the use of alternative fuels such as SRF. However, over the last few years, as data from the trade association, the MPA shows[xviii], the use of alternative fuels has, in much the same way as Household Waste recycling rates, stagnated.

In general, where commented upon, the reports assume that cement kiln acceptance of SRF will grow to a level of around 0.6-0.7Mt. Eunomia assumes that by 2030 1.0 Mt of Residual Waste will be sent to cement kilns. As explained in the report, the figure is based on "*theoretical capacity that can be used at technically capable cement kilns, at a fuel substitution rate of 40% in energy terms".* It adds "*in some cases this will be an under-estimate of what certain cement kilns are already accepting*".

Whilst the total consented capacity for the acceptance of waste at cement kilns in the UK is at least 1.4Mt, cement kilns typically accept a wide range of alternative fuels – including tyres and liquid based fuels. These fuels are generally more homogenous than SRF, and some cement kiln operators are understood to have a technical preference for them over SRF.

This review concludes that whilst the theoretical demand for SRF at cement kilns is at least 1.4Mt, based on current expectations, it is reasonable to assume that 50% of the demand will be taken by SRF.

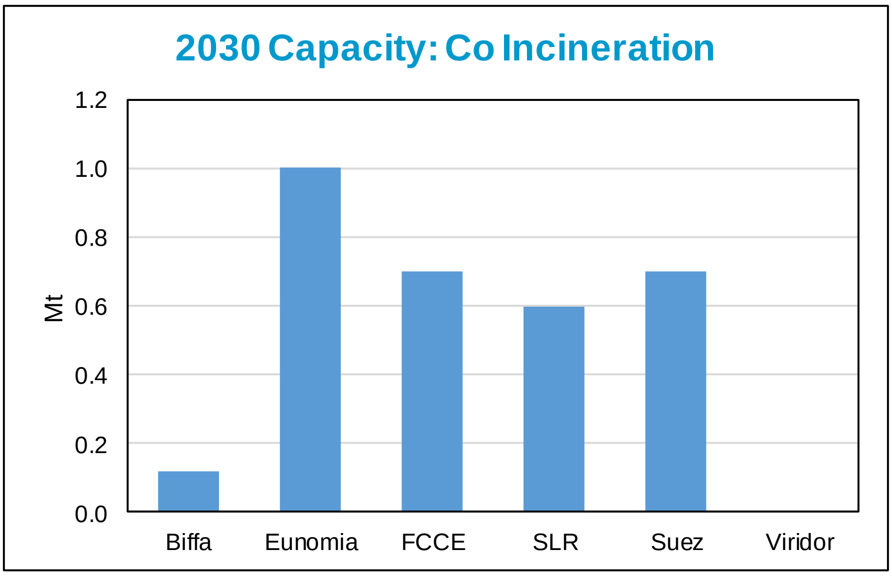


Figure 27: Projected 2030 Co-Incineration Source: Reports

Both Eunomia and Suez also identify the potential for specific IED compliant biomass facilities to convert capacity to be suitable for processing a Residual Waste feedstock. A recent report by Anthesis[xix] suggests a total waste wood demand for biomass of 4.7Mt by 2020 – although not all of this will be processed at IED complaint facilities. Eunomia have assumed 50% of IED complaint capacity will be potentially available for the processing of Residual Waste on the basis that such facilities "*could theoretically process RDF or SRF in the future*". This is estimated to be the equivalent of 1.7Mtpa.

In practice (subject to planning and permit) a biomass facility originally designed for waste wood is only likely to be modified into a facility for accepting RDF where, as Anthesis note, it either (a) misses the September 2018 deadline for ROC accreditation and so is no longer eligible as a biomass facility for subsidy support or (b) if the market dynamics change to such an extent that waste wood is no longer an economically attractive fuel.

Tolvik's own capacity assessment is similar to that of Anthesis - which suggests a potential over-capacity of around 0.5Mt – 1.0Mt. Some of this gap may be met by imports (e.g. from France and Germany) but it seems reasonable to assume that there will be a potential overcapacity of around **0.6Mt.** Given that several biomass facilities whose commissioning is already delayed are based on a technical configuration which may, with further investment in modifications, be capable of a switch to RDF, this figure is taken forward in the assessment of the 2030 capacity "gap".

5.3. The Effect of MBT

Based on the capacity of MBT facilities which is potentially available, Eunomia have modelled a significant increase in MBT capacity in 2030 when compared with the 2016 baseline (an increase from 1.2Mtpa to 3.3Mtpa), with part of this increase understood to be due to the way in which they allocate capacity to MBT which is co-located with EfW. This is also understood to explain why their projections for Certain EfW in Figure 25 are modestly lower than those in other reports.

Other reports take a more negative view of MBT, particularly given the announcement of the termination of the Manchester PFI contract and the publicity surrounding several other MBT based local authority contracts which are facing economic and technical challenges.

On balance this review has concluded that, without a policy change in the UK which directly drives the beneficial use of MBT (e.g. restriction on biodegradable waste to landfill), in the future MBT capacity is unlikely to be fully utilised and that the net effect of MBT on the Residual Waste market will be unchanged from 2016 levels.

5.4. Future levels of RDF export

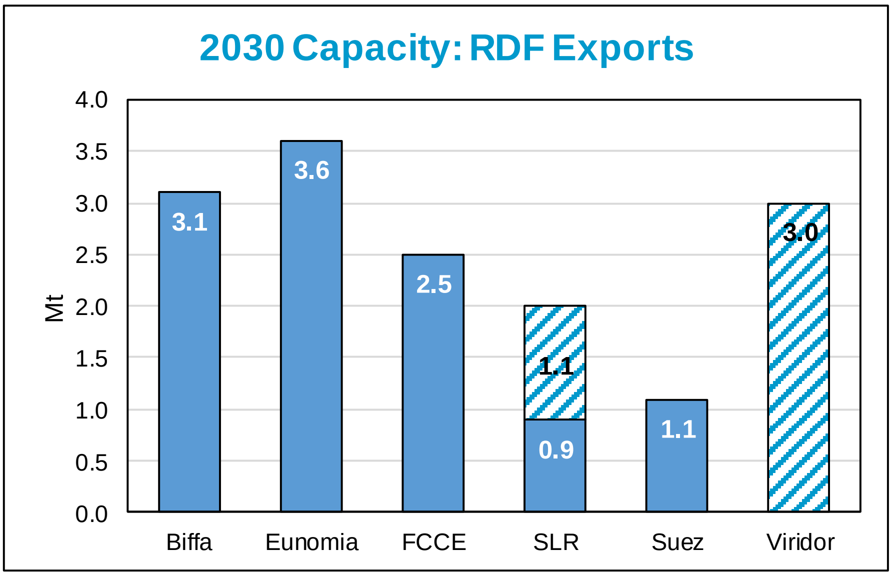


Figure 28: RDF Export projections (hatched areas reflect assumed ranges) Source: Reports

Figure 28 shows the projected level of RDF exports in the reports.

There is a common ground in the reports with respect to the current status of RDF exports. Specifically that the tonnages of RDF being exported from the UK have, over the last 12-18 months, levelled out and that since the Brexit vote, the weaker value of sterling has made RDF exports more expensive.

However, as Suez state, going forward "*the prognosis for exports of RDF is therefore highly uncertain*." This uncertainty arises as a consequence of both Brexit and the EU Circular Economy package.

Biffa's assessment is that "*some further capacity in mainland European EfW plants could become available if recycling rates in European increase as a result of new Circular Economy package*" - a view echoed by Eunomia: "*it appears likely that spare capacity on the continent will continue to grow. A number of EfW facilities are under construction, while residual waste arisings are set to decline as each nation strives to reach recycling targets for 2020 and beyond."*

This additional capacity in Europe can be either met by RDF from the UK or other EU countries. Biffa's expectation is similar to that of Suez assuming "*this spare capacity is likely to be targeted by other European countries which still mainly rely on landfill. Indeed this is what is advocated by the EU as part of its Circular Economy Package EfW action plan*" and their expectation is that, whilst not modelled, RDF exports from the UK will fall. Whilst Eunomia recognise that "*filling this capacity with residual waste from neighbouring countries will remain an attractive option",* they point to the fact that as the RDF export market is primarily capacity driven, European gate fees can fluctuate to maintain the competitiveness of RDF exports. Their expectation is that significant tonnages of RDF will continue to be exported from the UK.

Both SLR and Viridor exclude exports from their headline analysis. The SLR estimate in Figure 28 shows RDF exports based on the expected 2030 gap in its Business Case (at 0.9Mt) with the potential for this tonnage to increase to 2.0Mt depending on the development of Additional EfW and/or trends in the tonnages of Residual Waste.

Viridor's view is that RDF exports will continue to flow out of UK at a rate of 3Mtpa +/- 0.5Mt and the analysis in this review accordingly reflects this.

Overall, whilst this review concurs with Eunomia that "*the Residual Waste market has become a European one, so it seems unlikely that excluding RDF exports would be a sensible assumption*", the level of uncertainty and relationship between RDF exports and other market factors are such that, as with Additional EfW capacity, the projections of the "gaps" in Section 6 have therefore been calculated both including and excluding the impact RDF exports.

What is, however, critical to note in any assessment of the Residual Waste market is that:

- Very little, if any, RDF is currently committed to the export market for a period in excess of 10 years – so there is flexibility with respect to its future treatment;
- Post Brexit UK policy may influence the level of RDF exports;
- As Suez notes, the future level of RDF exports will be primarily driven by economics – the probability of Additional EfW capacity being (financed and) developed in the UK is heavily dependent upon its competitiveness with RDF exports.

5.5. Role of landfill

In their most recent report Eunomia includes an estimate that 2.0Mt of Residual Waste will continue to be landfilled. This relates to those tonnages of Residual Waste which Eunomia assesses will need to be landfilled and so are not "available" to the treatment market.

This issue was previously considered in the 2014 GIB report. This identified the potential for 5% of Municipal Waste being landfilled, consistent with the proposed landfill limits in the EU Circular Economy package *"if the market is to operate efficiently in environmental and economic terms…….recognising practical market limitations – e.g. geographic remoteness, seasonal variations in supply, changing waste composition or variations in the availability of treatment capacity."*

Clearly this is not a consideration in those European countries with bans on the landfilling of biodegradable waste. They appear to address issues such as seasonality and availability variations largely through an extensive network of inter-facility trading and interim storage arrangements.

For the UK there are therefore two potential scenarios:

- There is no change in approach to the issue in the market - in which case it is reasonable to assume “practical” over-capacity will emerge significantly in advance of “nominal” over-capacity – so limiting the availability of Residual Waste;
- Arrangements are developed as in Europe to ameliorate variations in Residual Waste supply over time and so no allowance need be made in the gap analysis for landfilling of Residual Waste.

This review assumes that in the period to 2030 there will be a commercial incentive upon operators to avoid landfill and so ensure an extensive network of storage arrangements. However, this is an issue which is outside the scope of this review and requires further research and future consideration by policy makers and operators.

5.6. Total 2030 Residual Waste Treatment Capacity

Figure 29 summarises the analysis in this section which estimates a projected Residual Waste treatment capacity, based on Certain dedicated EfWs, of **16.6Mt**.

When this is combined with the expected level of Additional EfWs constructed prior to 2022 and projected level of RDF exports, the total Residual Waste treatment capacity available to the UK market is projected to be **21.1Mt**.

Mt	Median	Range Down	Range Up
Dedicated EfW	14.5	(0.2)	0.8
MBT Impact	0.8	(0.3)	0.6
IED Biomass	0.6	(0.6)	0.6
Co-Incineration	0.7	(0.1)	0.3
UK Capacity	**16.6**	**(1.2)**	**2.3**
Additional EfW prior to 2022	2.0	(0.1)	0.4
RDF Export	2.5	(0.5)	0.5
Total	**21.1**	**(1.8)**	**3.2**

Figure 29: Projected Total 2030 Residual Waste Treatment Capacity

6. MODELLING THE CAPACITY GAP

6.1. Review Findings

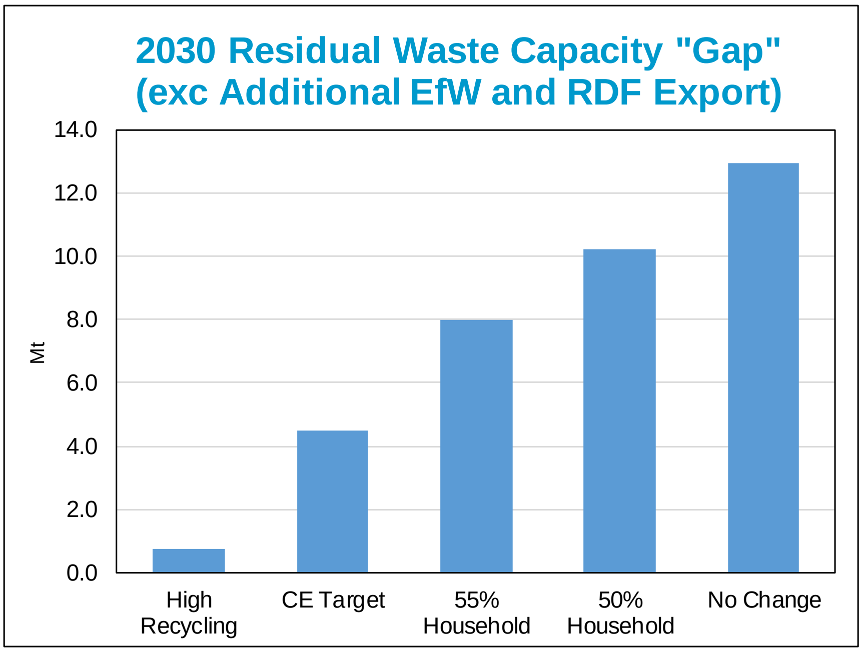


Figure 30: Projected 2030 Residual Waste Capacity Gap: Excluding RDF Export and Additional EfW

Figure 30 shows the projected "capacity gap" in 2030 when the five Residual Waste tonnage projections in Section 4 are combined with the analysis of the projected Residual Waste capacity in Section 5 but with additional EfW capacity and RDF exports excluded.

Scenario	2030 Residual Waste Tonnes *(Figure 22)*	2030 UK Capacity exc. additional EfW and RDF Exports *(Figure 29)*	2030 Gap exc. additional EfW capacity and RDF Exports
No Change	**29.5**	(16.6)	**13.0**
50% Household	**26.8**		**10.2**
55% Household	**24.2**		**8.0**
CE Target	**21.0**		**4.5**
High Recycling	**17.3**		**0.7**

Figure 31: 2030 Projected Capacity Gap in the UK – excluding additional EfW capacity and RDF exports

Figure 31 shows, in the 55% Household scenario, for example, a shortfall in Residual Waste treatment capacity based only on Certain EfW capacity in the UK of around **8.0Mt**.

Scenario	2030 Gap exc. additional EfW capacity and RDF Exports	Additional EfW Capacity (to 2022)	2030 Gap exc. RDF Exports	Projected RDF Exports in 2030	2030 Gap inc. RDF Exports
No Change	**13.0**	(2.0)	**11.0**	(2.5)	**8.5**
50% Household	**10.2**		**8.2**		**5.7**
55% Household	**8.0**		**6.0**		**3.5**
CE Target	**4.5**		**2.5**		**0.0**
High Recycling	**0.7**		**(1.3)**		**(3.8)**

Figure 32: 2030 Projected Capacity Gap in the UK – including Additional EfW capacity and RDF exports

Figure 32 shows the effects of Additional EfW capacity of 2.0Mtpa and RDF exports assumed at 2.5Mtpa, on the gap; suggesting in the 55% Household scenario that 3.5Mt of Residual Waste would continue to be landfilled in 2030.

The analysis also confirms that in the Circular Economy scenario, after allowing for the construction of Additional EfWs and RDF exports by 2030 the market would be at over-capacity.

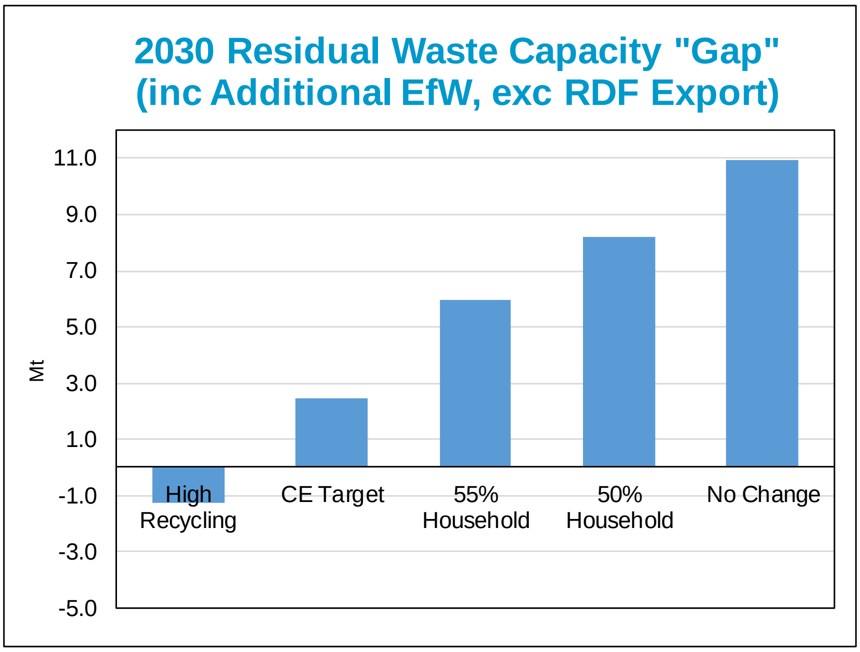


Figure 33: Projected 2030 Residual Waste Capacity Gap: Excluding RDF Export

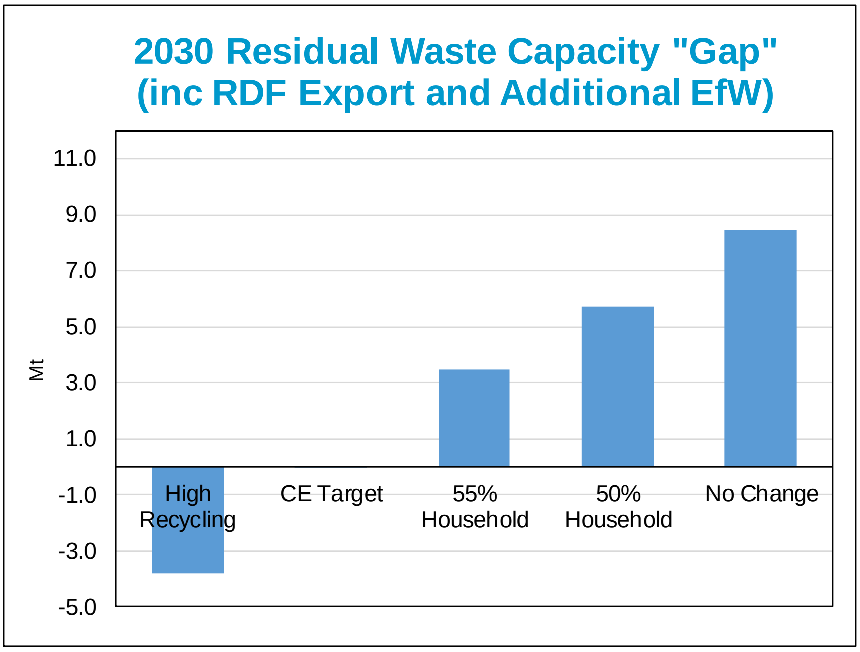


Figure 34: Projected 2030 Residual Waste Capacity Gap

6.2. Projection Uncertainty

Note that, for ease of interpretation, the analysis in Section 6.1 is based on the median data points and excludes the identified uncertainty ranges.

However, the compound impact of these uncertainties, for example on the 55% Household scenario, are potentially significant. Whilst the median suggests a gap of 3.5Mt, as shown in Figure 35 the range of uncertainty is (1.6)Mt to 7.5Mt.

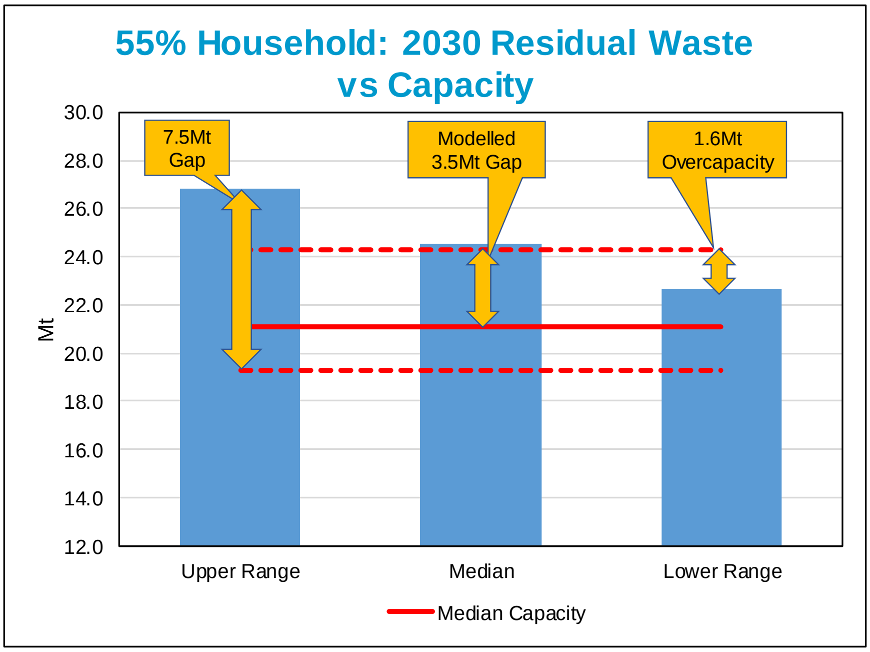


Figure 35: 55% Household: 2030 Residual Waste vs Capacity after allowing for margins of error

7. MATTERS ARISING

7.1. The Role of Policy and Recycling Assumptions

The differing outcomes from the five scenarios in Section 4.6 of the review highlights the sensitivity of the Residual Waste market to recycling assumptions. Future recycling levels will depend upon a complex range of factors, including but not limited to (particularly for England) post Brexit waste policy, availability of funding, markets for secondary materials, public attitudes to recycling and available treatment capacity.

Furthermore, it has been suggested that, post Brexit, the UK could move towards targets which are not weight based. Whilst potentially offering superior environmental outcomes, assessing the effects of such policies on the Residual Waste market would add further complexity.

It is beyond the scope of this review to consider such issues but it is apparent that the uncertainty which results from an absence of long term policy direction inevitably increases the risk of a mismatch between tonnages of different wastes (both Residual Waste and recyclables) and treatment/disposal capacity. Such uncertainty may serve to discourage capital investment in the sector and any resultant mismatches are unlikely to be either economically nor environmentally beneficial.

7.2. Implications for Landfill

The focus of this review has been through the prism of Residual Waste treatment capacity with the implicit assumption that, assuming bans on the landfilling of biodegradable waste are not introduced outside of Scotland, landfill will always be available as the "balancing" capacity. Figure 36 shows the total tonnages of Residual Waste assumed to be landfilled in the period to 2030 under the five scenarios.

Scenario	Residual Waste to landfill 2018-2030 (Mt)
No Change	**105.2**
50% Household	**85.7**
55% Household	**69.2**
CE Target	**43.9**
High Recycling	**27.7**

Figure 36: Assumed tonnage of Residual Waste to Landfill

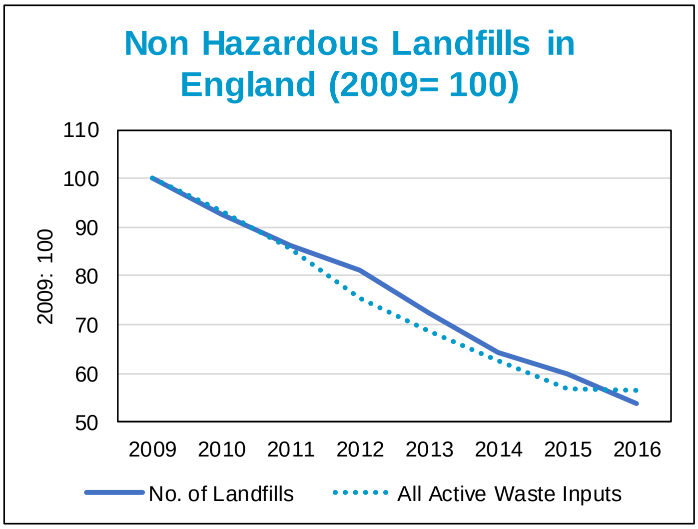


Figure 37: Non Hazardous Merchant Landfills in England accepting >25ktpa Source: EA, Tolvik analysis

As Figure 37 shows there is also clear evidence that for the last 8 years the number of operational landfills is reducing at least as fast as tonnages to landfill. These closures have not always resulted from capacity exhaustion – closures have also been made on commercial grounds.

With landfill also having a key role to play in the management of a range of wastes which do not fall within the definition of Residual Waste in this review, the EA recently calculated[xx] that there may be only 6.8 years of life remaining in England's non-hazardous landfills. With the same document pointing to regional landfill life ranging from 1.4 years to 13.6 years, the potential risk of regional shortfalls in landfill capacity before 2030 appears high. Whilst Residual Waste can, and does travel between regions, lack of regional landfill capacity may have consequences for the Residual Waste market, particularly during unplanned shutdowns of EfWs.

For the market to therefore operate effectively, future policy will need to recognise the role that landfill has to play – including (as highlighted in Section 6.5) the potential for landfill in the longer term to be used for interim storage of Residual Waste.

7.3. Regional Variations

The focus of this review is upon the UK market as a whole. However, there are significant regional variations – both in terms of the supply of Residual Waste and current and projected treatment capacity. These differences have been highlighted in the Suez report who note the limitations of a national Residual Waste market analysis as facilities "*are invariably sized to cater for local or regional waste management catchments and specific market needs."*

As the Suez report also notes, the "natural regions" for waste are more typically defined by transport networks and can be very different from administrative regions.

Detailed modelling of these regional differences is beyond the scope of this review – not least because there is the added complexity of the movement of Residual Waste between regions to consider. This is becoming increasingly common as larger scale dedicated EfWs are developed and regional variations in landfill capacity (as discussed in Section 7.2) arise.

Good quality data relating to both the geographical source of waste which is accepted at waste facilities and locations to which waste is removed is therefore key to analysing the geographical need for all forms of additional waste treatment capacity, including EfW.

7.4. Understanding C&I Waste

As Section 2.2 notes, data on C&I Waste is poor and as a consequence this review has not sought to compare the C&I Waste arisings data used to inform the individual reports.

Future analysis will be greatly aided by consistent classification and interpretation of the available data on the C&I Waste market; and it is hoped that the ongoing waste data group meetings held between DEFRA and a range of industry stakeholders will help achieve this objective.

7.5. Changing composition of Residual Waste

The characteristics of Residual Waste are determined both by the composition of waste arisings as well as the nature of recycling activities.

For simplicity, the analysis in this review has assumed a consistency in Residual Waste – and in particular a consistent CV. As the limited data which is available suggests that long term movements of Residual Waste CV over time across the UK as a whole have been relatively limited, an average 10% movement in the CV of Residual Waste in the UK could change the 2030 capacity gap analysis by +/- 1.5Mt.

In this context it is noted that not all EfWs report CV in their annual returns and this would assist in monitoring long term market trends.

7.6. Misclassification of Residual Waste to Landfill

Section 3.2 notes the uncertainty surrounding the tonnage of Residual Waste being sent to landfill. This is likely to be in part due to the misclassification (whether deliberate or otherwise) of Residual Waste at the "lower tax" rate and in part due to the misclassification of wastes under the EWC codes.

In 2016, EWC code 19 12 12 was used for in excess of 9 Mt of landfilled waste in the UK. A site by site review reveals patterns which suggest some waste producers are using 19 12 12 to describe all Residual Waste. This appears to be on the basis that the waste has previously undergone treatment (and so cannot be coded as 20 03 01), but that it is not a "Refuse Derived Fuel" (and so cannot be coded as 19 12 10). Others use 19 12 12 to describe fines – whether or not inert. These differences will have a direct impact on the future assessment of landfill inputs.

It would therefore be beneficial if the Environment Agency to issue some guidance on classification of wastes under 19 12 12 to assist the future analysis and understanding of the Residual Waste market.

GLOSSARY

ACT	Advanced Conversion Technology
Additional EfW	EfWs which are not Certain EfWs
C&D	Construction and Demolition (Waste)
CE	Circular Economy
Certain EfW	EfWs which are currently operational, in construction or for which all finance and consents are in place and for which construction is imminent
C&I Waste	Commercial & Industrial Waste
CHP	Combined Heat and Power
CV	Calorific Value
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EU	European Union
EfW	Energy from Waste
EWC	European Waste Catalogue
HIC	Household, Commercial and Industrial
HMRC	Her Majesty's Customs and Excise
Household Waste	As defined by the Environmental Protection Act 1990
IED	Industrial Emissions Directive
Ktpa	'000s tonnes per annum
Mt	Million Tonnes
MBT	Mechanical Biological Treatment
MRF	Materials Recycling Facility
Municipal Waste	Household waste and that from other sources which is similar in nature and composition to household waste
NIEA	Northern Ireland Environment Agency
NRW	Natural Resources Wales
ONS	Office of National Statistics
Residual Waste	Waste which remains after recycling
RDF	Refuse Derived Fuel
SEPA	Scottish Environment Protection Agency
SRF	Solid Recovered Fuel

APPENDIX 1 – DATA TABLES

2016 Residual Waste Inputs into Cement Kilns

Facility	19 02 10	19 12 10	19 12 12	Total ktpa
Cauldon		12		12
Hope		14		14
Ketton	1	1	50	51
Ribblesdale		27	2	28
Rugby	45	127		172
South Ferriby	24			24
Tunstead		17		17
Aberthaw (Est)		15		15
Padeswood (2015)		32		32
Grand Total	**70**	**245**	**52**	**366**

Figure A1: Estimates of Residual Waste to UK Cement Kilns in 2016 Sources: WDI 2016, Tolvik data

19 12 12 Impact on Landfill Tonnages

Mt	All HIC (Estimate)	Municipal Waste (Estimate)	Adjust for 19 12 12	Residual Waste
England	14.4	12.2	2.6	9.5
NI	0.6	0.5	0.1	0.4
Scotland	2.2	1.9	0.0	1.9
Wales	0.5	0.5	0.1	0.4
Total	**17.8**	**15.0**	**2.8**	**12.2**

Figure A2: Estimates of Residual Waste to landfill Source: EA, SEPA, Tolvik analysis

Assumed 2016 Household Waste

Region	Arisings (Mt)	Residual Waste (Mt)
England	23.5	13.4
Scotland	2.5	1.3
Wales	1.4	0.6
Northern Ireland	0.9	0.5
UK Total	**28.2**	**15.9**

Figure A3: Household Waste Baseline Data for 2016 Source: Tolvik estimates from DEFRA/SEPA/StatsWales/NIEA

APPENDIX 2 – SOURCE REFERENCES

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