TOLVIK CONSULTING

The Waste and Bioenergy Experts

UK Energy from Waste Statistics – 2018

June 2019

INTRODUCTION

Tolvik's fifth annual report on the UK Energy from Waste ("EfW") sector brings together data from a range of sources into a single document. Following engagement with the Environment Agency, Environmental Services Association and individual EfW operators, we are pleased to see a clear movement towards increased standardisation in reporting (largely via the Annual Performance Reports ("APR") prepared by operators in accordance with permit requirements). To some extent 2018 represents a "transition" period between the new reporting systems and the old.

For the first time, we have reported on compliance, including emissions to air. We previously excluded analysis from the report due to data uncertainty; we are pleased to note here too there has been movement, in England at least, towards consistent reporting. Given the significance of emissions to stakeholders, we believe there is merit to further develop this area of analysis in subsequent editions of this report.

This year we have excluded references to gate fees as this will be subject to a separate report which we plan to release later in 2019.

As previously, the focus of this report is upon conventional moving grate EfWs and Advanced Conversion Technology ("ACT") facilities generating energy from the combustion of Residual Waste. Residual Waste is defined as non-hazardous, solid, combustible mixed waste which remains after recycling activities. This definition is a little broader than that for Municipal Waste but primarily includes wastes falling within European Waste Catalogue ("EWC") 19 12 10, 19 12 12 and 20 03 01. The report continues to exclude EfW facilities in Jersey and the Isle of Man, cement kilns and facilities solely processing Waste Wood or other biomass wastes.

We would like to take the opportunity to thank all those who have assisted us in the preparation of this report.

Copies of this report can be downloaded via www.tolvik.com. Third parties are entitled to freely use the contents of the report, subject to appropriately acknowledging its source.

CONTENTS

Front Cover Image: Allerton Park EfW, fully operational in 2018 Courtesy: Amey

1. SUMMARY OBSERVATIONS

- In 2018 the tonnage of Residual Waste processed at EfWs in the UK was up 5.6% to 11.5Mt;
- At the end of 2018, there were 47 EfWs operational or in late commissioning and 15 EfWs in construction. The long term projected EfW capacity based on EfWs which were operational or in construction increased during the year by 0.9Mt when compared with 2017. The increase was a result of a combination of new projects and increases in consented capacity at existing facilities;
- In preparing this report we have identified a number of market themes.

Poor turbine reliability	The stand out operational issue for 2018 was that total power export was unchanged on 2017 despite increased inputs. This was due to at least 6 EfWs experiencing significant turbine difficulties during the year. The key question is whether this poor reliability was a "blip" or part of a longer term trend.
Challenges around commissioning and early operations **for new technologies** and less experienced operators	EfW inputs in 2018 were significantly lower than we projected in the 2017 report. This was due to significant commissioning delays on a number of projects. As at January 2019, the 3 ACTs which commenced construction in the period 2012-2014 had an average construction period of 63 months with an average delay to takeover of 19 months. For the 6 EfW/ACT starting construction in 2015 the equivalent figures were an average 42 months construction with an average of 17 months delay. We believe it is highly likely that there will be project failures in 2019, if nothing else as a result of the exhaustion of construction phase cashflows.
Build it and they will come ….?	In the last 12 months, 2 EfWs reached financial close where the project was based on a long term Residual Waste supply contract with an aggregator (for whom underlying contracts are typically relatively short term). This suggests strong investor confidence in the project's future waste sourcing strategies.
Optimisation initiatives are progressively increasing capacity	For the 15 EfWs which became fully operational in the period 2012 to 2017, on average 2018 Residual Waste inputs were 4.4% higher than the average over the preceding 3 years.
Increased focus on managing the calorific value of waste feedstocks	The composition of Residual Waste in the future will depend on how individual Local Authorities respond to DEFRA's Waste and Resources Strategy(1). Whilst on average across all operational EfWs material year-on-year changes in calorific value are unlikely, smaller EfWs dependent on a limited number of Local Authority suppliers for their tonnage could be adversely impacted.
Existing consents (both planning & permits) **will continue to be increased**	Permits and planning consents continue to be increased for existing EfWs – by as much as 20% over the original consented capacity, reflecting operational optimisation and providing EfW operators with additional flexibility.
Cyclical pattern of **EfW construction**	New orders for EfWs seem to follow 3 yearly cycles, 2012/13, 2015/16 and based on the last 9 months activity, 2018/19. This can create a challenge for specialist contractors with multiple projects at a similar stage of development and commissioning.
Efficiency and heat in focus	Operators continue to seek heat offtake opportunities and export continues to rise steadily. The most recent example being Wilton 11 which exported 100GWh of heat. Our expectation is that this will continue but with specific exceptions in the near term industrial heat solutions are likely to be the more deliverable.
Incineration tax will increasingly become a subject of debate	Hansard's record of parliamentary affairs recorded 9 refences to Incineration tax in 2018, compared to nil during the preceding 3 years. By end of March 2019 there were 5 references. The debate will no doubt continue.

2. MARKET OVERVIEW

The EfWs falling within the scope of this report are listed in Appendix 1.

As at December 2018 there were 42 fully operational EfWs in the UK, with a further 5 EfWs accepting waste during the year as part of late stage commissioning. As a result, total Headline Capacity was 13.48Mtpa. At the same time there was a further 3.37Mtpa of EfW capacity either in construction or about to commence construction. The 6% increase in total Headline Capacity in 2018 was a result of 4 EfWs reaching financial close during 2018 together with modest increases in consented capacity at several operational EfWs.

Mtpa	Fully Operational	In Late Stage Commissioning	Total Headline Capacity	In Construction	Total
2014	6.77	1.65	8.42	N/A	N/A
2015	8.87	1.21	10.08	4.16	14.24
2016	10.48	1.28	11.76	4.16	15.92
2017	11.85	0.41	12.26	3.64	15.90
2018	**12.41**	**1.07**	**13.48**	**3.37**	**16.85**

Figure 1: Headline Capacity (as at December 2018) Source: Tolvik analysis

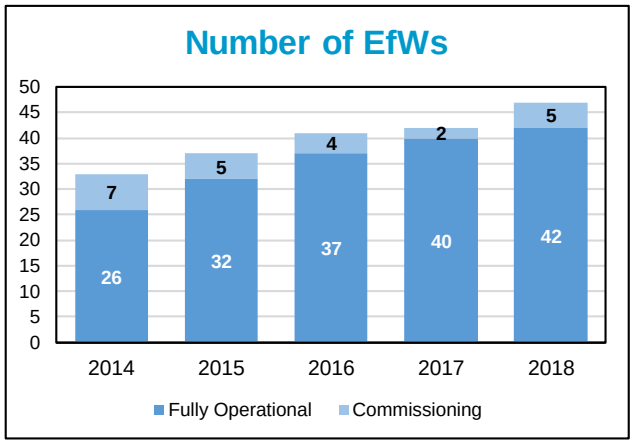


Figure 2: Number of EfW Facilities

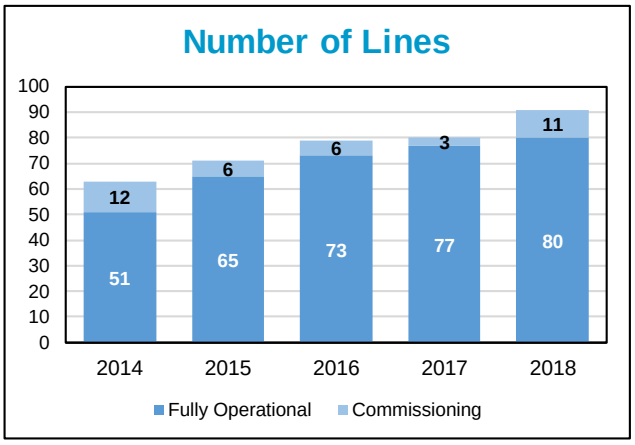


Figure 3: Number of Lines at EfW Facilities

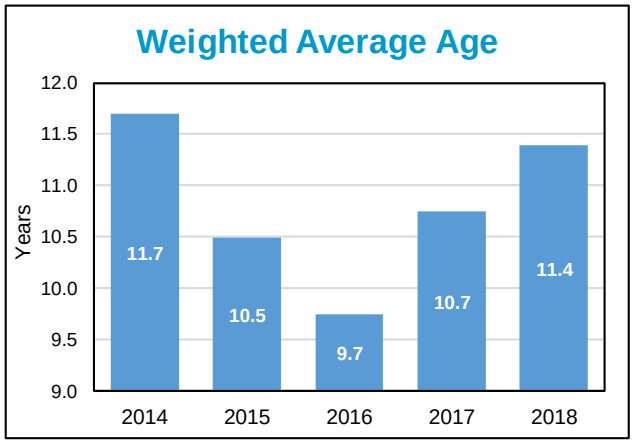


Figure 4: Weighted Average Age by Capacity (as at December 2018) Source: Tolvik analysis

Figure 4 shows the capacity-weighted average age of UK EfWs.

2018 was the second consecutive year in which there was an increase in the overall average age, reflecting that as the total EfW capacity in the UK increases, the impact of newly operational EfWs on the average age is proportionally less significant.

It is worth noting that 1.24Mt of Headline Capacity was built in the 1970's with the next oldest EfW reaching its 25th operational anniversary this year.

3. WASTE INPUTS

In 2018 a total of 11.49Mt of Residual Waste was processed in UK EfWs, an increase of 5.6% on 2017. Not unsurprisingly, as in 2017, the rate of growth has continued to slow down from the 2013-16 peak.

Total inputs were the equivalent, for EfWs operational throughout the year, to 91% of the total Headline Capacity – not dissimilar to the figure for previous years.

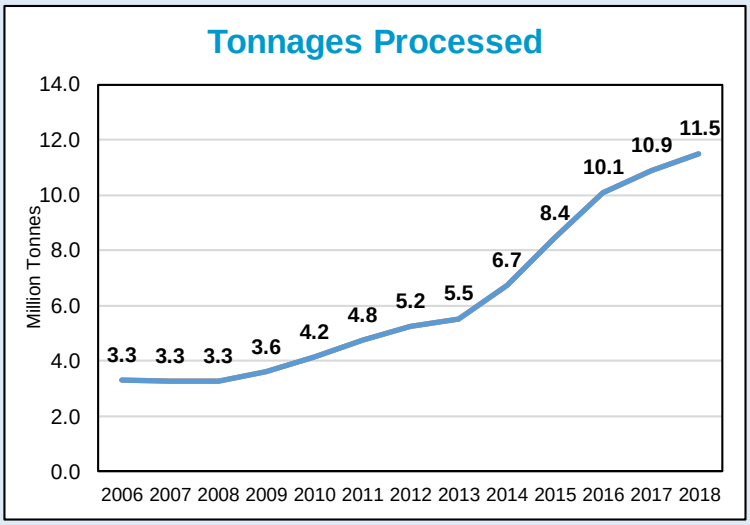


Figure 5: Total Tonnage of waste accepted at EfWs in 2006-2018
Source: APR [2]

Mt	Input Tonnage	Inputs as % of Headline Capacity
2014	6.72	88.2%
2015	8.45	89.0%
2016	10.10	91.0%
2017	10.88	90.8%
2018	**11.49**	**91.0%**

Figure 6: Annual EfW Inputs
Source: APR

The Role of EfW in the UK Residual Waste Market

In 2018 it is estimated that Residual Waste inputs to EfWs in the UK represented 41.8% *(2017: 39.5%)* of the overall UK Residual Waste market.

It was projected in the 2017 report that 2018 would see the tonnage of Residual Waste sent to EfW in the UK exceed the tonnage sent to landfill – however this proved not to be the case as a result of the commissioning challenges faced by a number of EfWs during the year (see Section 1).

It is estimated that in 2018 RDF Exports from the UK declined by around 8% when compared with 2017.

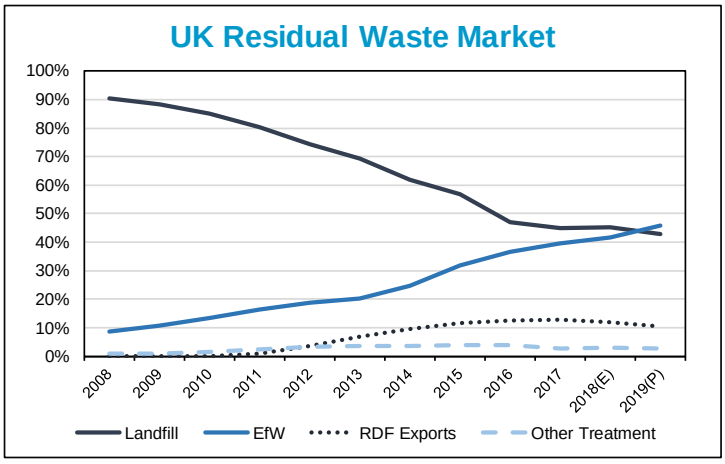


Figure 7: Development of the UK Residual Waste Treatment; 2018 Estimate and 2019 Provisional Source: Tolvik analysis

EfW Inputs by Waste Source and Type

Based on a detailed review of APRs for 2018 and Wastedataflow[3] for 2017/18, it is estimated that in 2018 82.4% of all EfW inputs were derived from Residual Local Authority Collected Waste ("LACW") with the rest being Commercial and Industrial ("C&I") Waste.

The continued (albeit modest) increase in C&I Waste inputs reflects the development of "merchant" EfW capacity in the UK.

Year	Waste Source	
	LACW	C&I Waste
2014/15	85.4%	14.6%
2015/16	85.1%	14.9%
2016/17	83.2%	16.8%
2017/18	84.4%	15.6%
2018	82.4%	17.6%

Figure 8: Inputs by Waste Source Source: Wastedataflow, APR

Input by EWC Codes

According to available data, 68.7% of inputs to EfW in 2017 (the last year for which data was available) was unprocessed Municipal Waste with a further 30.5% of inputs being Residual Waste arising after prior treatment.

Year	EWC Code		
	20 03 xx	19 12 10 or 19 12 12	Other Codes
2017	68.7%	30.5%	0.8%

Figure 9: Inputs by EWC Source: EA Incinerator Waste Returns[4]

Net Calorific Value of Residual Waste

There was very limited reporting of Net Calorific Value ("NCV") in the 2018 APR and this data was insufficient to provide any evidence of meaningful trends.

Tolvik's most recent analysis of operator NCV data (from a variety of sources, some of which was under confidentiality) relates to 2017. This data suggested that the average NCV for Residual LACW in 2017 was 8.9MJ/Kg and for Residual C&I Waste was 11.0MJ/Kg. As previously reported, there is a very wide range of results and so these averages need to be treated with caution.

Operator Market Shares

In 2018 Veolia and Viridor had the greatest market share by operator based on input tonnages. There has been no material change in market shares since 2017.

Operator	Input (kt)	Share
Veolia	2,362	20.6%
Viridor	2,277	19.8%
Suez	2,092	18.2%
FCC	1,364	11.9%
Council	922	8.0%
Cory	740	6.4%
MFE	647	5.6%
MES	390	3.4%
Other	694	6.0%
Total	**11,487**	**100.0%**

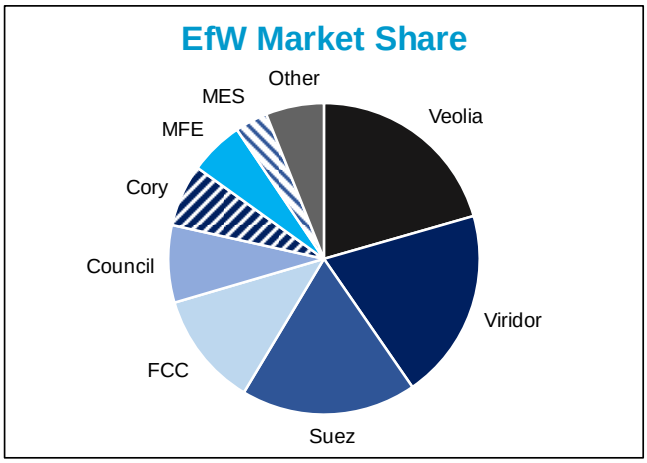


Figure 10: 2018 Share of Input Tonnage (includes Joint Ventures) Source: Tolvik analysis, (figures may not add up due to rounding)

4. ENERGY

The total power exported by EfWs in the UK in 2018 was 6,153GWh – approximately 1.9% of total UK generation. Despite a 5.6% increase in Residual Waste inputs in 2018, major turbine issues at 6 operational EfWs means that the total power export showed little change on 2017. As a consequence, in 2018 the average power generated per tonne fell to 536kWh/t.

	Est. Gross Power Generation GWh_e	Net Power Export GWh_e	Parasitic Load (excl. power import)	Parasitic Load (incl. power import)	Average Net kWh/tonne input	Net Heat Export GWh_{th}
2014	3,936	3,368	14.4%	N/A	468	N/A
2015	5,460	4,636	15.1%	N/A	549	554
2016	6,120	5,214	14.8%	15.3%	516	730
2017	7,146	6,187	13.4%	14.2%	569	865
2018	**7,074**	**6,153**	**13.0%**	**14.0%**	**536**	**1,112**

Figure 11: 2018 Power Generation Source: Tolvik analysis

Notwithstanding these challenges, for those EfWs reporting in the APR, parasitic loads (expressed as a percentage of total power generation) continued the steady improvement in efficiency seen in recent years.

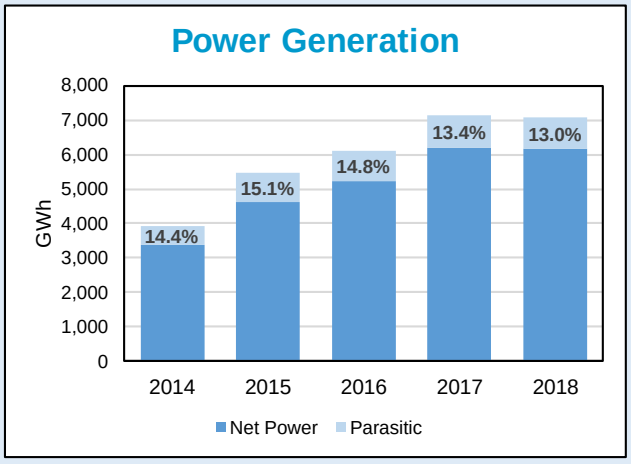


Figure 12: Power Generation from EfW

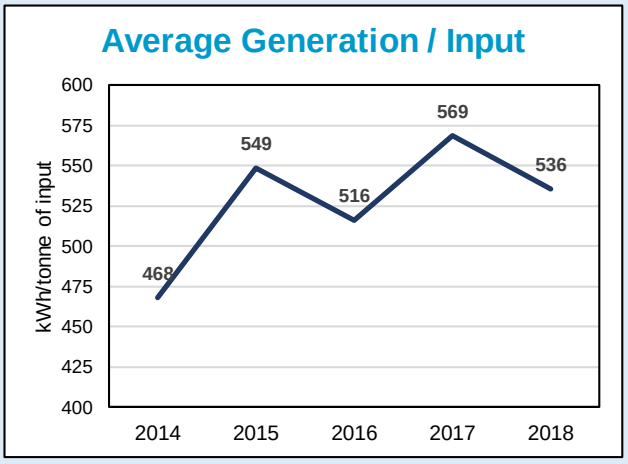


Figure 13: Average Power Generation per tonne of input

Power: Benchmarking

For each EfW, for which data was reported, Figures 14 and 15 show the distribution of the average net power exported per tonne of input and the average parasitic power load for the year.

With an average 536kWh/t generated per tonne of waste input in 2018 *(2017: 569kWh/t),* across all EfWs the output ranged from Bolton with no power exported during the year to 906kWh/t. Ferrybridge FM1 once again by some margin delivered the highest figure which in part reflects its feedstock (solely RDF with a higher NCV), optimised design and the fact that it does not export heat.

Data on parasitic loads in 2018 was less readily available than in 2017 but for those EfWs which reported loads ranged between 8.9% (Severnside) and 20.0% (Leeds which uses power for other onsite activities) with an average of 13.0%.

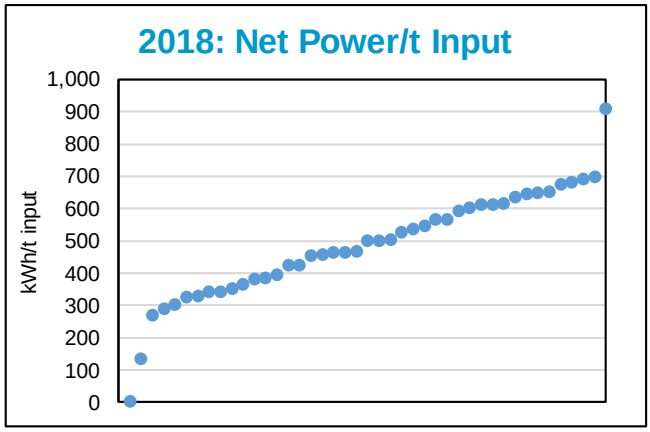


Figure 14: 2018 Net Power Exported per tonne of Input
Source: Tolvik analysis, 43 records

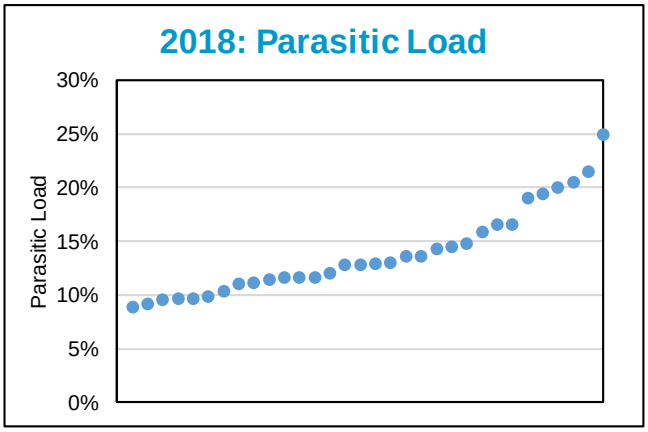


Figure 15: 2018 Parasitic Load Distribution
Source: Tolvik analysis, 32 records

Beneficial Heat Use

In 2018 10 EfWs in the UK exported heat for beneficial use alongside power with an estimated total export of 1,112GWh$_{th.}$ *(2017: 865GWh$_{th}$).* Across all EfWs this was the equivalent of 97kWh$_{th}$/tonne of inputs *(2017: 80kWh$_{th}$/tonne)*.

EfW	Est. Export GWh$_{th}$		Heat/Steam Offtake
	2018	2017	
Runcorn	408	405	Steam supply to Ineos
Eastcroft	332	224	Enviroenergy for electricity generation and hot water
Sheffield	112	96	District heating operated by Veolia
Wilton 11	100	-	Adjacent Wilton International site
Devonport	59	54	Adjacent naval dock yard
Gremista	40 (est)	40 (est)	District heating on the Shetland Islands
SELCHP	38	37	District heating operated by Veolia
Coventry	11	5	District heating operated by Engie
Leeds	8	-	District heating operated by Vital Energi
NewLincs	3	3	To industry (produced 17GWh$_{th}$ but limited demand)
Total	**1,112**	**865**	

Figure 16: EfWs Exporting Heat Source: APR

Efficiency and R1

As at January 2019 across the UK 28 EfWs (67% of the number of operational EfWs, 79% of the Headline Capacity) were accredited as R1 (“Recovery”) operations.

No Scottish EfWs were reported as being R1 accredited.

5. OPERATIONS

In 2018 EfW availability, based on average operational hours for each EfW, fell to 87.3%, due to two smaller facilities having availability below 40%. A new measure has been introduced in this report, the capacity weighted availability, which acknowledges that it is often more challenging to maintain high availability at smaller EfWs. In 2018 this was 89.8% - largely unchanged from previous years.

As Table 17 shows IBA and APCr produced per tonne of input waste have fallen modestly in recent years.

	Availability - Hours		% of Input Tonnage		
	Simple Average	Capacity Weighted Average	Incinerator Bottom Ash ("IBA")	Air Pollution Control Residue ("APCr")	Metals Recovery (if reported)
2014	89.0%	89.2%	20.3%	3.5%	1.9%
2015	88.3%	88.7%	20.4%	3.5%	1.9%
2016	90.2%	90.3%	20.2%	3.5%	1.9%
2017	88.6%	89.3%	20.1%	3.4%	1.9%
2018	**87.3%**	**89.8%**	**19.9%**	**3.3%**	**1.9%**

Table 17: Operational Data Source: APR

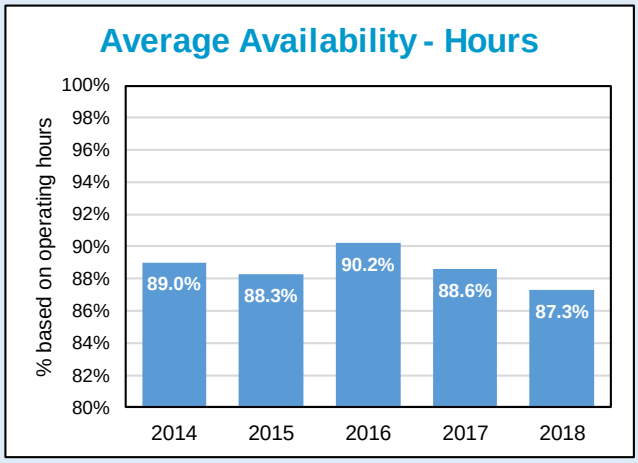


Figure 18: Average EfW Availability - Hours

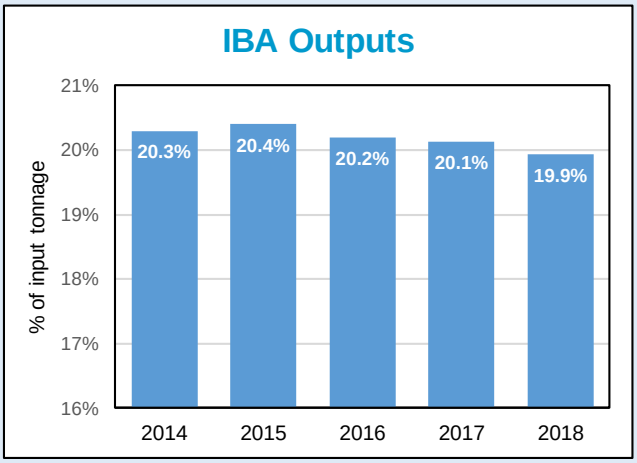


Figure 19: Trend in IBA Outputs

Availability

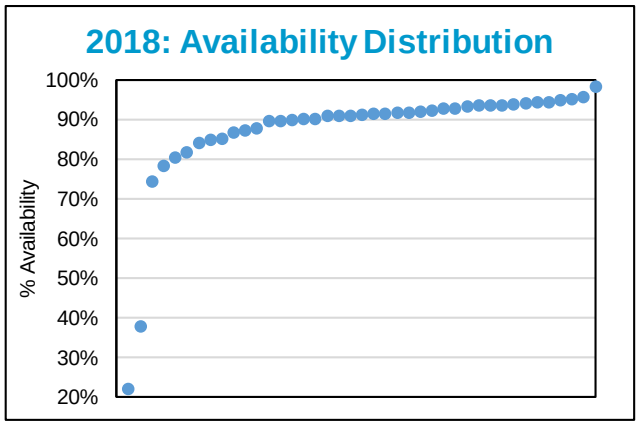


Figure 20: 2018 Availability Distribution
Source: Tolvik analysis, 41 records

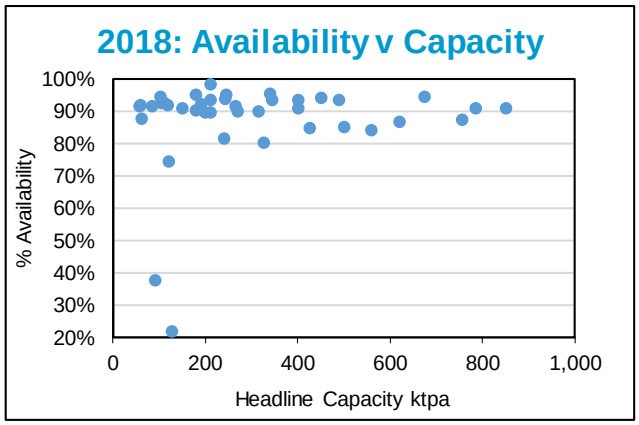


Figure 21: 2018 Availability vs EfW Headline Capacity
Source: Tolvik analysis, 41 records

Operator	Simple Average Availability	Capacity Weighted Average
MFE	94.5%	94.5%
Veolia	94.4%	94.3%
MES	91.5%	91.1%
Cory	91.1%	91.1%
FCC	90.0%	87.9%
Suez	88.2%	88.0%
Council	83.8%	84.4%
Viridor *	79.5%	83.4%
Other	77.5%	77.1%
Average	**87.3%**	**89.8%**

Figure 22: 2018 Average Availability by Operator

MFE, operator of Ferrybridge FM1, had the highest reported average operator availability whilst Veolia's Portsmouth had the highest availability for an individual facility of 98.5% in 2018.

Viridor's* average as reported in Figure 22 was adversely impacted by Bolton (22% availability following major fire in late 2017). Excluding Bolton, Viridor's average would have been 89.0%.

With the exception of two EfWs – Bolton and Milton Keynes ACT, all others EfWs had an availability in excess of 75%.

Outputs

Incinerator Bottom Ash

In 2018 IBA accounted on average for 19.9% *(2017: 20.1%)* of all waste inputs. In total, the tonnage of IBA generated was 2.3Mt.

IBA outputs expressed as a percentage of waste inputs generally fell within the 11% - 25% range, with Allington, as a fluidised bed facility, once again reporting the lowest percentage. Almost all IBA is now recycled rather than landfilled.

Air Pollution Control Residue

In 2018, APCr generation was 3.3% of waste inputs *(2017: 3.4%)*.

The total generation of APCr in 2018 was reported to be 378kt, an increase of circa 5% on 2017. Allington, as a large fluidised bed EfW once again produced the greatest portion of APCr as a percentage of inputs.

In 2017 it was estimated that around 20% of APCr was recycled. Figures for 2018 are not currently available.

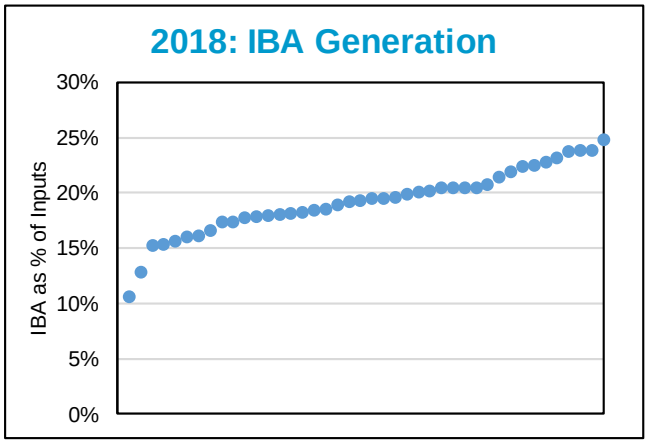


Figure 23: 2018 Distribution of IBA Generation (as % of inputs)
Source: Tolvik analysis, 41 records

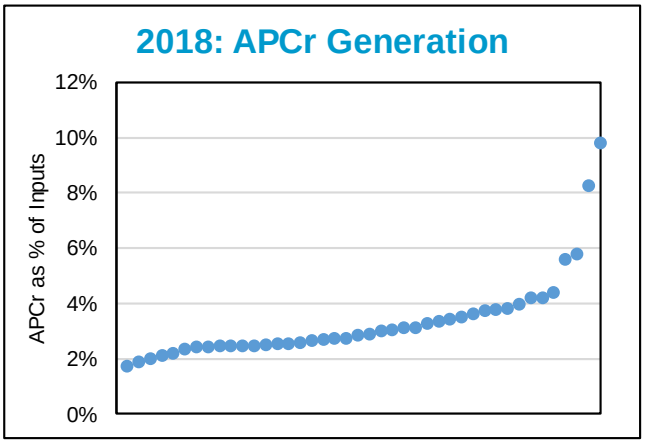


Figure 24: 2018 Distribution of APCr Generation (as % of inputs)
Source: Tolvik analysis, 41 records

Consumable Use

The level of data reporting relating to the use of consumables - specifically water, lime (or other alkaline reagents), urea and carbon in the APR continues to rise. Data is generally calibrated to "Specific Usage" i.e. usage per tonne of input and this is the approach taken in this report.

To date there have been no discernible trends across UK EfWs, in part because, as Figure 25 shows, consumable use varies greatly from facility to facility, and changes in the mix of facilities impacts on the overall UK performance.

Consumable	Unit	Year	Low	Median	High
Total Water Usage (both potable and non-potable)	m^3/ tonne input	2016	0.05	0.29	2.24
		2017	0.03	0.24	2.66
		2018	**0.06**	**0.28**	**3.54**
Activated carbon or coke	kg/ tonne of input	2016	0.03	0.30	1.79
		2017	0.06	0.25	1.20
		2018	**0.05**	**0.26**	**0.60**
(Hydrated) lime or sodium bicarbonate		2016	3.92	9.87	30.91
		2017	1.87	9.74	31.88
		2018	**1.82**	**9.80**	**23.90**
Urea		2016	0.04	1.83	3.39
		2017	0.62	2.36	4.40
		2018	**0.01**	**1.54**	**3.39**
Ammonia		2017	0.62	2.36	4.40
		2018	**0.56**	**1.70**	**4.13**

Figure 25: Specific Consumable Usage (where reported) Source: APR, 34 records

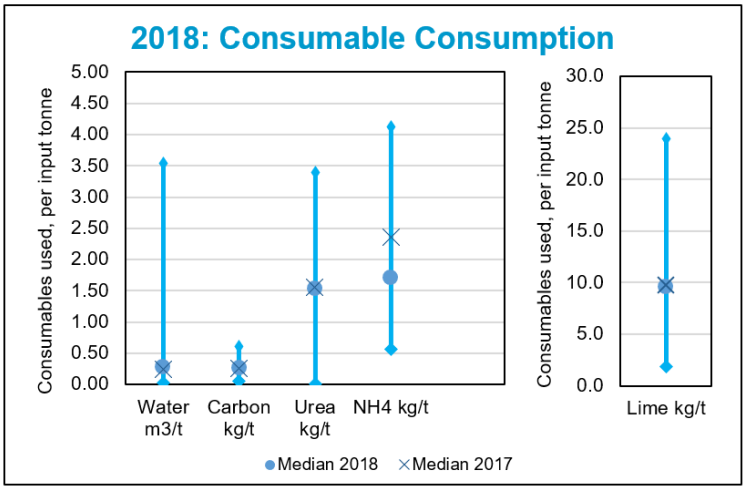


Figure 26: Average Specific Consumable Usage (where reported) Source: APR, 34 records

6. COMPLIANCE

Background

This section of the report is new for 2018. Compliance in the EfW sector is a combination of operator self-monitoring, reporting to and monitoring by the relevant regulator (EA, SEPA, NRW and NIEA).

EfWs, like most large industrial installations, are required under EU and UK law to monitor their emissions to air both continuously (on site) and periodically (by sample sent to an accredited laboratory). Emissions to water and composition of ash residues are also monitored at regular intervals.

General permit compliance (as measured in England by the OPRA score) is assessed by the regulator whilst operators are now being requested to include details of "abnormal operations" in their APR. In this context abnormal operations are defined as *"any technically unavoidable stoppages, disturbances, or failures of the abatement plant or the measurement devices, during which the emissions into the air and the discharges of waste water may exceed the prescribed maximum Emission Limit Value ("ELV")".*

To date the focus of compliance has typically been at a facility level, but there is an increasing stakeholder interest in the performance of the UK EfW sector as a whole.

Emissions to Air – Continuous Monitoring by EfWs

The data presented in this section relates to 37 of the 42 EfWs fully operational during 2018 – or the equivalent of approximately 92% by 2018 inputs in the UK. Data on the remaining EfWs was not provided as part of regulator responses to a Freedom of Information Act request. Across all continuously monitored substances, on average in 2018 emissions were 28% of the ELV *(2017: 31%).*

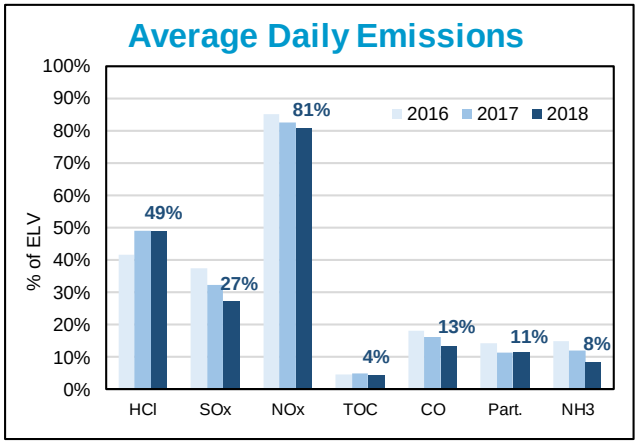


Figure 27: Average Continuously Monitored Emissions from EfWs
Source: APR and Tolvik analysis

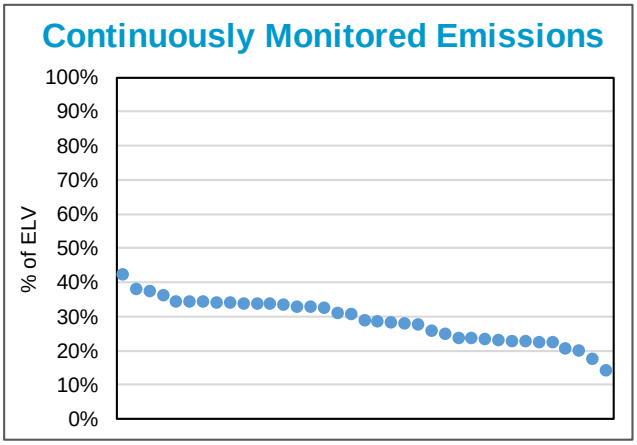


Figure 28: 2018 Distribution of Continuously Monitored Emissions
Source: APR and Tolvik analysis, 37 records

The emission levels of Hydrogen Chlorides (HCl), Sulphur Dioxide (SOx) and Oxides of Nitrogen (NOx) are controlled by the dosing rate of consumable reagents (see Section 5). Typically in the UK, operators look to optimise resource consumption against achieving emissions levels within the specified ELV.

Emissions to Air – Periodic Assessments

EfW permits also specify the type and frequency (usually bi-annually) of sampling to be undertaken of various specific substances emitted.

Figure 29 shows the results of these periodic assessments in 2018 those EfWs reporting data ranging between 3% and 14% of the ELV. Operators advise that measurement uncertainty, limits of detection for small samples and impact of background pollutant levels can all affect the analysis, but that the protocols used by the sector should be such that reported results are effectively a worst case.

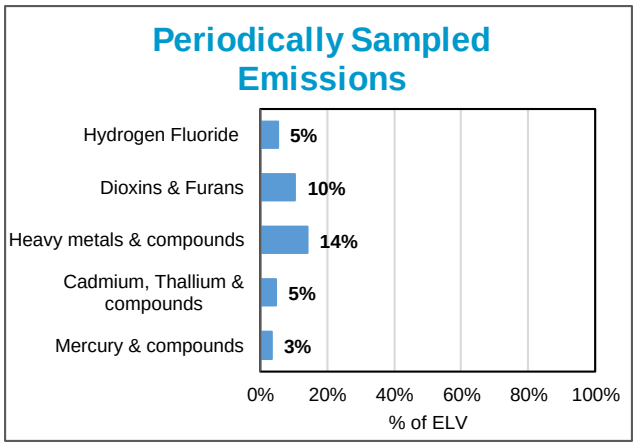


Figure 29: Periodically Sampled Emissions by substance
Source: APR and Tolvik analysis, 32 records

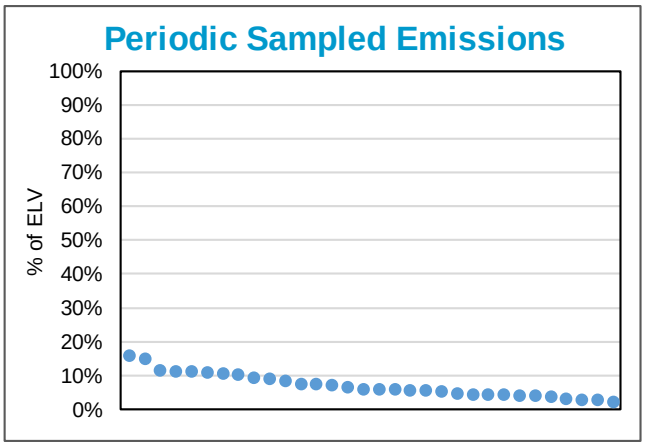


Figure 30: 2018 Distribution of Periodically Sampled Emissions
Source: APR and Tolvik analysis, 32 records

Abnormal Operations

39 of the 42 fully operational EfWs reported the cumulative hours, per line, of abnormal operations during 2018 with an aggregated total of 130 hours - just 0.02% of cumulative operating hours across all lines during 2018.

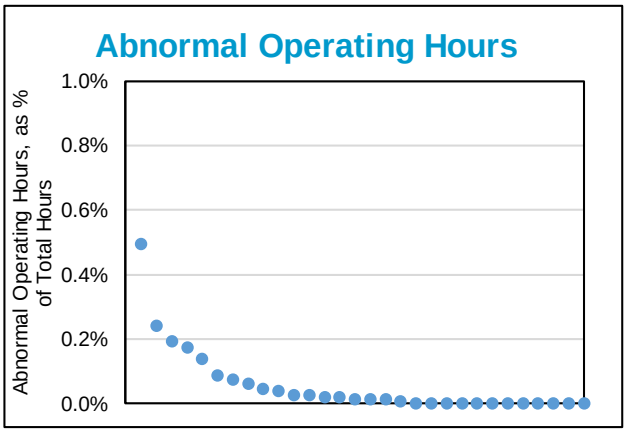


Figure 31: Abnormal Operating Hours, as % of Total Operating Hours Source: APR and Tolvik analysis, 39 records

Operational Risk Assessment ("OPRA") Scores

All permitted facilities have an OPRA score or equivalent provided by the relevant regulatory authority. A score of A represents the "best" assessment. Using the latest available data for 2017, the previous steady improvement in OPRA scores appears to have been somewhat reversed.

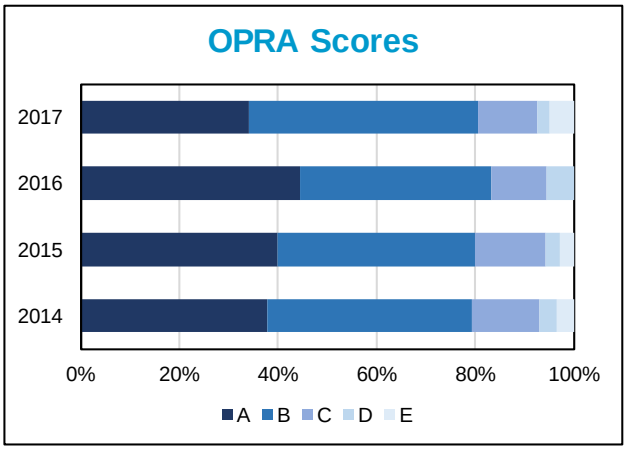


Figure 32: OPRA Scores by Facility Source: EA, SEPA[(2)]

7. CAPACITY DEVELOPMENT

Based on EfWs which were operational or in construction as at December 2018, Section 2 identifies a Headline Capacity of 16.85Mt. Headline Capacity is not suitable for projecting future EfW capacity in any analysis of the UK Residual Waste market; this is more appropriately measured by the "Operational Capacity". It is estimated (based upon the EfWs listed in Figures 37 to 40 in Appendix 1, that by 2023 the UK Operational Capacity will be **16.9Mt.** This reflects an increase of 1.2Mt from the 2017 projection as a result of additional projects reaching financial close and increases in capacity at existing operational facilities.

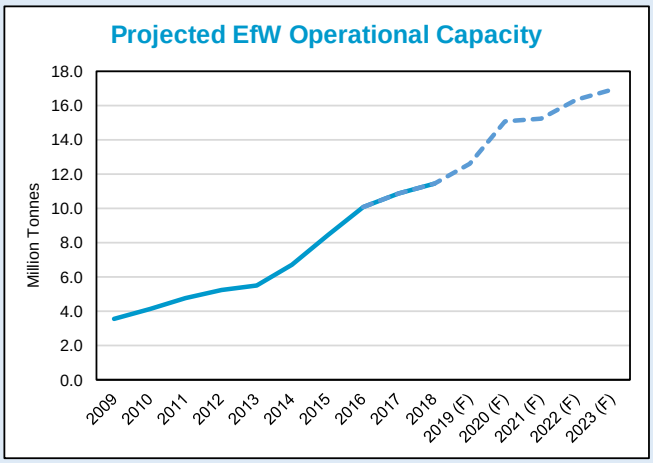


Figure 33: Projected UK EfW Operational Capacity Source: Tolvik analysis

EfW in Development – Additional Capacity

The actual Operational Capacity beyond 2023 will be dependent upon the development of additional EfWs. Tolvik's databases (which are a representation of the market but cannot be guaranteed to be comprehensive), show 16.3Mtpaof Headline Capacity which either is seeking planning consent, have planning consent or for which planning consent has been refused but some form of appeal/new submission is expected.

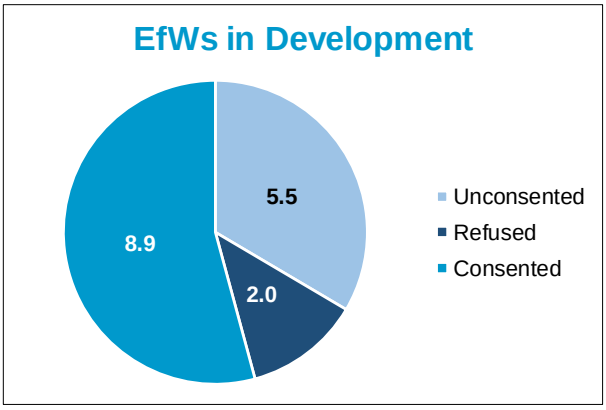


Figure 34: EfW Capacity in Development - by planning status (in Mtpa) Source: Tolvik analysis

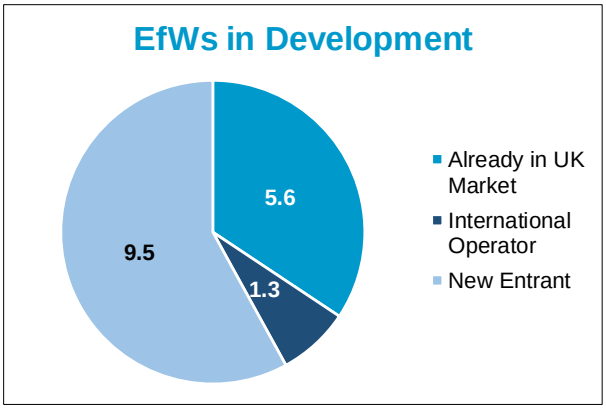


Figure 35: EfW Capacity in Development - by developer In Mtpa) Source: Tolvik analysis

55% of this potential additional EfW capacity has planning consent.

Just over a third of the potential additional capacity is being developed by those who are already active in the UK EfW market – either as an operator or as a funder, a further 7% is supported by international EfW operators whilst the remainder (>50%) is being developed by parties with no prior experience in the EfW sector.

APPENDIX 1: ENERGY FROM WASTE FACILITIES INCLUDED IN THE REPORT

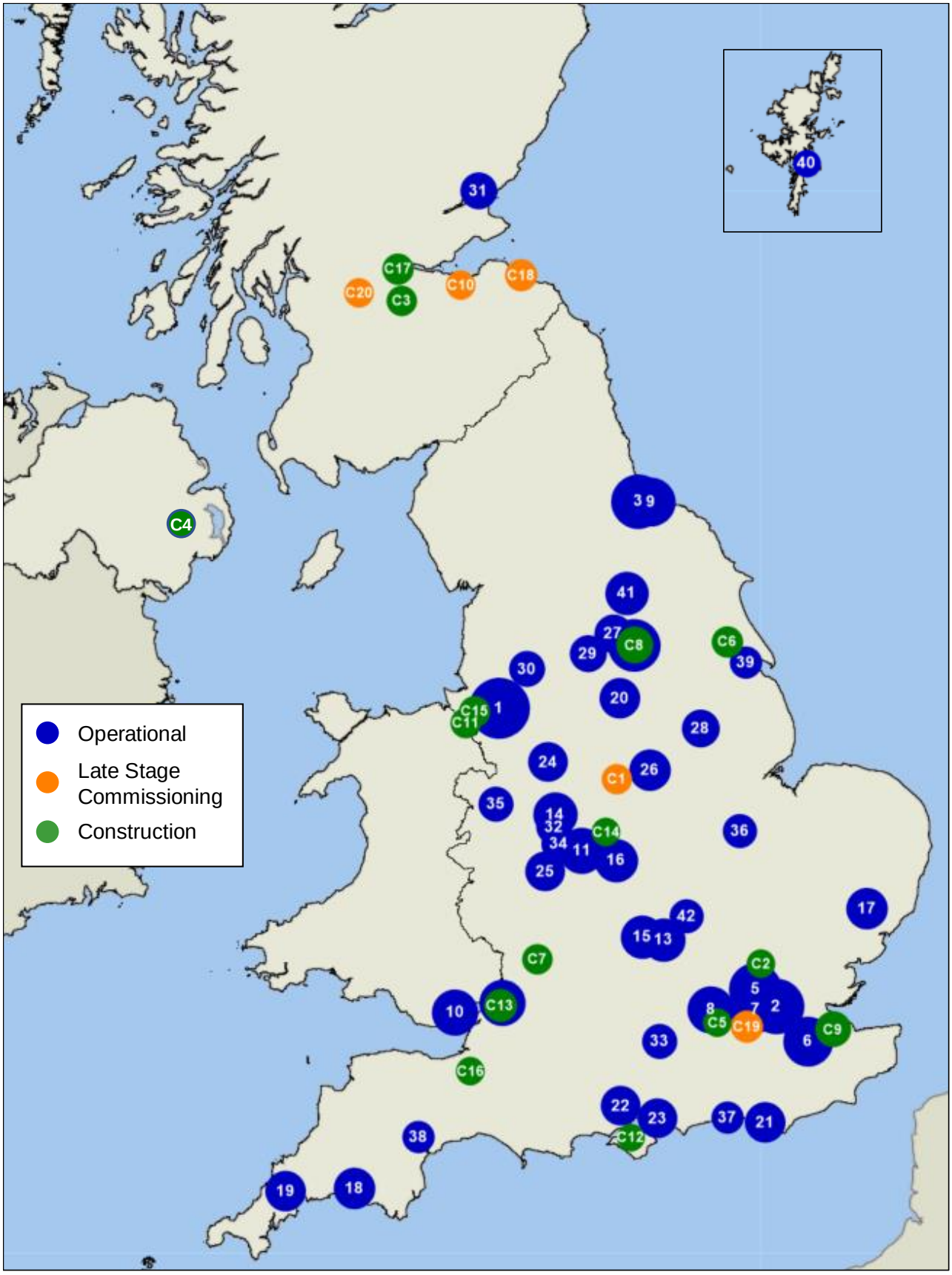


Figure 36: Location of EfW facilities (for further details on the EfWs shown see Figure 37-39)

Operational EfWs

	Permitted Name	Known As	Location	Operator	Capacity (ktpa)	Processed (ktpa) 2017	Processed (ktpa) 2018
1	Runcorn EfW Facility	Runcorn	Halton	Viridor	850	891	884
2	Riverside Resource Recovery Facility	Riverside	Bexley	Cory	785	746	740
3	Tees Valley - EfW Facility	Tees Valley	Stockton-on-Tees	Suez	756	563	637
4	Ferrybridge Multifuel 1	Ferrybridge FM1	Wakefield	MFE	675	632	647
5	EcoPark Energy Centre	Edmonton	Enfield	Council	620	511	518
6	Allington Waste Management Facility	Allington	Kent	FCC	560	484	492
7	SELCHP ERF	SELCHP	Lewisham	Veolia	488	446	441
8	Lakeside EfW	Lakeside	Slough	Lakeside [1]	450	456	431
9	Wilton 11 EfW	Wilton 11	Middlesborough	Suez	500	393	467
10	Cardiff Energy Recovery Facility	Trident Park	Cardiff	Viridor	425	363	376
11	Tyseley ERF	Tyseley	Birmingham	Veolia	400	341	343
12	Severnside Energy Recovery Centre	Severnside	S.Gloucestershire	Suez	400	323	377
13	Greatmoor EfW	Greatmoor	Buckinghamshire	FCC	345	291	308
14	Staffordshire ERF	Four Ashes	Staffordshire	Veolia	340	338	336
15	Ardley EfW Facility	Ardley	Oxfordshire	Viridor	326	286	290
16	CSWDC Waste to Energy Plant	Coventry	Coventry	Council	315	293	289
17	SUEZ Suffolk - EfW Facility	Great Blakenham	Suffolk	Suez	269	262	264
18	Devonport EfW CHP Facility	Devonport	Plymouth	MVV	265	251	255
19	Cornwall Energy Recovery Centre	Cornwall	Cornwall	Suez	240	250	221
20	Sheffield ERF	Sheffield	Sheffield	Veolia	245	230	234
21	Newhaven ERF	Newhaven	East Sussex	Veolia	242	223	224
22	Integra South West ERF	Marchwood	Southampton	Veolia	210	202	199
23	Integra South East ERF	Portsmouth	Portsmouth	Veolia	210	202	207
24	Stoke EfW Facility	Hanford	Stoke-on-Trent	MESE	210	184	186
25	EnviRecover EfW Facility	Hartlebury	Worcestershire	Severn [2]	200	197	200
26	Eastcroft EfW Facility	Eastcroft	Nottingham	FCC	180	151	177
27	Leeds Recycling and ERF	Leeds	Leeds	Veolia	180	172	187
28	Lincolnshire EfW Facility	North Hykeham	Lincolnshire	FCC	190	169	171
29	Kirklees EfW Facility	Kirklees	Huddersfield	Suez	150	132	124
30	Bolton ERF [3]	Bolton	Gtr Manchester	Viridor	127	49	29
31	Baldovie Waste To Energy Plant	Baldovie	Dundee	MVV	120	84	93
32	Wolverhampton EfW Facility	Wolverhampton	Wolverhampton	MESE	118	112	110
33	Integra North ERF	Chineham	Hampshire	Veolia	110	93	93
34	Dudley EfW Facility	Dudley	Dudley	MESE	105	95	94
35	Battlefield EfW Facility	Battlefield	Shropshire	Veolia	102	97	96
36	Peterborough EfW Facility	Peterborough	Peterborough	Viridor	85	79	81
37	Enviropower Ltd, Lancing	Lancing	West Sussex	Enviropower	60	33	60
38	Exeter ERF	Exeter	Devon	Viridor	60	56	58
39	Integrated Waste Management Facility	NewLincs	NE Lincolnshire	Tiru	56	54	51
40	Energy Recovery Plant	Gremista	Shetland Islands	Council	26	23	23
41	Allerton Waste Recovery Park	Allerton Park	North Yorkshire	Amey	320	107	244
42	Milton Keynes Waste Recovery Park	Milton Keynes ACT	Milton Keynes	Amey	90	17	27
	In Commissioning						200
			Totals		**12,405**	**10,881**	**11,487**

Figure 37: Operational EfWs in 2018 Source: APR

[1]Viridor/Grundon Joint Venture [2]FCC/Urbaser Joint Venture [3]Major Fire, September 2017

EfWs in Late Stage Commissioning

	Permitted Name	Known As	Location	Operator	Start Date	Headline Capacity (ktpa)	Net Input 2018 (ktpa)
C1	Sinfin IWTC	Sinfin Road ACT	Derby	Renewi	Q3 2014	158	50
C10	Millerhill RERC	Millerhill	Edinburgh	FCC	Q2 2016	163	16
C18	Dunbar ERF	Dunbar	East Lothian	Viridor	Q3 2015	300	40
C19	Beddington ERF	Beddington Lane	Croydon	Viridor	Q4 2015	303	80
C20	Glasgow RREC	Polmadie ACT	Glasgow	Viridor	Q4 2012	150	7
				Early commissioning inputs			6
				Total		**1,074**	**200**

Figure 38: EfWs In Late Stage Commissioning as at December 2018
Source: Tolvik estimates based on various information sources, (figures may not add up due to rounding)
Please note: C1 Total inputs to site not necessarily processed tonnage

EfWs In Construction

	Permitted Name	Known As	Location	Developer	Start Date	Capacity (ktpa)
C2	Hoddesdon EfW Plant	Hoddesdon ACT	Hertfordshire	Bouygues	Q2 2014	90
C3	Levenseat Renewable Energy	Levenseat ACT	West Lothian	Outotec	Q2 2015	180
C4	Full Circle Generation EfW	Belfast ACT	Belfast	Bouygues	Q3 2015	120
C5	Charlton Lane Eco Park	Eco Park ACT	Surrey	Suez	Q2 2016	60
C6	Hull Energy Works	Energy Works ACT	Hull	Engie	Q1 2016	227
C7	Javelin Park ERF	Javelin Park	Gloucestershire	Urbaser/Balfour	Q3 2016	190
C8	Ferrybridge Multifuel 2	Ferrybridge FM2	Wakefield	MFE	Q3 2016	675
C9	Kemsley Park EfW	Kemsley	Kent	WTI	Q3 2016	550
C11	Parc Adfer ERF	Parc Adfer	Deeside	WTI	Q4 2016	200
C12	Isle of Wight EfW	Isle of Wight	Isle of Wight	Amey	Q2 2017	30
C13	Severn Road RRC	Avonmouth	Bristol	Viridor	Q1 2017	350
C14	Baddersley EfW	Baddersley	Warwickshire	Equitix	Q1 2018	100
C15	Hooton Park Sustainable Energy	Hooton Park ACT	Merseyside	BWSC/Cogen	Q4 2018	266
C16	Bridgwater Resource Recovery	Bridgwater	Somerset	Equitix/Iona	Q4 2018	100
C17	Earls Gate Energy Centre	Earls Gate	Falkirk	Earls Gate [3]	Q4 2018	237
				Total		**3,375**

Figure 39: EfWs In Construction in 2018 Source: Tolvik analysis
[3] Brockwell Energy Ltd/Covanta/GIG Joint Venture

Developments January 2019 – May 2019

	Type of Change	Known As	Location	Additional Capacity (ktpa)
N/A	Financial Close since December 2018	Rookery South	C Bedfordshire	545
N/A		Lostock	Cheshire West	600
1	Increase in Permitted Capacity at Operational EfWs	Runcorn	Halton	250
4		Ferrybridge FM1	Wakefield	50
25		Hartlebury	Worcestershire	30
			Total	**1,475**

Figure 40: EfWs Developments Source: Tolvik analysis

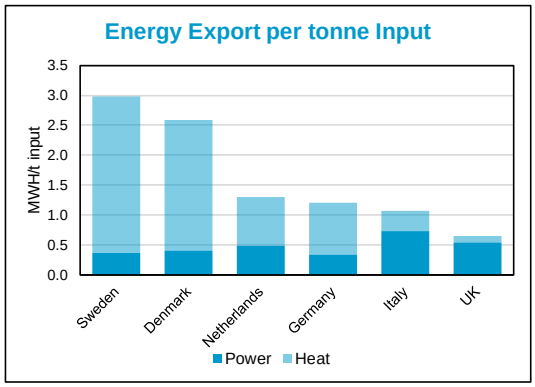
APPENDIX 2: INTERNATIONAL BENCHMARKS

As in previous years, this report has pulled together the latest available published EfW data from other northern European countries for the purposes of a comparison with the UK EfW market. There will be differences in the categorisation of EfW facilities and in the calculation/measurement methodologies applied, but it is hoped that the data provides a useful high-level overview of some key operational metrics.

Country	Data Year	Reported Inputs (Mt)	Associated Capacity (Mt)	Inputs as % of Headline Capacity
Sweden [5]	2017	6.15	6.51	94.5%
Denmark [6]	2015	3.58	3.79	94.5%
Germany [7]	2017	23.49	24.38	96.3%
Netherlands [8]	2017	7.63	8.20	93.0%
UK	**2018**	**11.49**	**12.61**	**91.0%**

Figure 41: Reported EfW data used for benchmarking Sources: As per Appendix 3[5-8]

As Figure 42 shows, whilst in the UK EfWs are largely focussed on electricity export, in most other European markets energy is exported through a mix of power, hot water and steam.



Country	Electricity (MWh/t)	Heat (MWh/t)	Total (MWh/t)
Sweden	0.36	2.62	2.98
Denmark	0.40	2.19	2.59
Netherlands	0.48	0.81	1.30
Germany	0.34	0.86	1.20
Italy	0.73	0.33	1.07
UK	**0.54**	**0.10**	**0.64**

Figure 42: Latest European Benchmarks – Energy Export, (figures may not add up due to rounding)

The UK's figures for IBA, APCr and metal outputs are broadly in line with the rest of Europe.

Country	IBA	APCr	Metals
Sweden	16.1%	4.4%	
Denmark	17.0%	3.0%	
Germany	25.1%	4.3%	2.2%
Netherlands	25.0%	2.2%	1.7%
UK	**19.9%**	**3.3%**	**1.9%**

Figure 43: European Benchmarks – Ash and Metal Outputs

APPENDIX 3: DATA SOURCES

(1) DEFRA: *Our Waste, Our Resources: A Strategy for England* – December 2018
https://www.gov.uk/government/publications/resources-and-waste-strategy-for-england

(2) APR either provided by operators or released under the Freedom of Information Act.

EA: Contains public sector information licensed under the Open Government Licence v3.0.

NIEA: Contains public sector information licensed under the Open Government Licence v3.0.

NRW: Contains Natural Resources Wales information © Natural Resources Wales and database right.

SEPA: Contains SEPA data © Scottish Environmental Protection Agency and database right 2018. All rights reserved.

(3) http://www.wastedataflow.org/ Q100 for four quarters Apr 2017 – Mar 2018

(4) Environment Agency: 2017 Waste Data Interrogator – Incinerator Waste Returns
https://data.gov.uk/dataset/dd8629ad-bd32-4db3-a07a-879737964f23/waste-data-interrogator-2017

(5) Sweden - Avfall Sverige: Svensk Avfallshantering 2018

(6) Denmark - BEATE Benchmarking af affaldssektoren 2016 (data fra 2015) Forbrænding

(7) Germany - ITAD: Jahresbericht 2016/17

(8) Netherlands - Afvalverwerking in Nederlands, gegevens 2017

APPENDIX 4: GLOSSARY

ACT	Advanced Conversion Technology
APCr	Air Pollution Control residue
APR	Annual Performance Reports
C&I	Commercial and Industrial Waste
EA	Environment Agency
EfW(s)	Energy from Waste (facilities)
ELV	Emission Limit Value
EWC	European Waste Catalogue
Headline Capacity	The maximum annual throughput contained within the Environmental Permit except where an operator has publicly reported an alternative figure.
IBA	Incinerator Bottom Ash
Kt (pa)	'000s tonnes (per annum)
LACW	Local Authority Collected Waste
Mt (pa)	Million tonnes (per annum)
NIEA	Northern Ireland Environment Agency
NCV	Net Calorific Value
NRW	Natural Resources Wales
OPRA	Operational Risk Assessment
RDF	Refuse Derived Fuel
Residual Waste	Solid, non-hazardous, combustible waste which remains after recycling either treated (in the form of an RDF or SRF) or untreated (as "black bag" waste).
SEPA	Scottish Environmental Protection Agency

TOLVIK CONSULTING

The Waste and Bioenergy Experts

Adrian Judge

Chris Jonas

Sally Freshwater

CONSULTING

MARKET ANALYSIS

DUE DILIGENCE

Tolvik Consulting Ltd is a privately-owned specialist provider of independent market analysis, commercial due diligence and advisory services across the waste and biomass sectors.

Our clients include the UK's leading waste companies, project finance investors, developers and equity investors.

This report has been written by Tolvik Consulting Ltd on an independent basis using our knowledge of the current UK waste market and with reference inter alia to various published reports and studies and to our own in-house analysis.

This report has been prepared by Tolvik Consulting Ltd with all reasonable skill, care and diligence as applicable. Whilst we have taken reasonable precautions to check the accuracy of information contained herein, we do not warrant the accuracy of information provided.

Tolvik Consulting Limited, The Old Vicarage, Fairmead, Cam, Dursley, Gloucestershire GL11 5JR

Tel: +44 (0)1453 519048 Email: info@tolvik.com

www.tolvik.com