TOLVIK CONSULTING

The Waste and Bioenergy Experts

UK Energy from Waste Statistics – 2021

May 2022

INTRODUCTION

Tolvik's eighth annual report on the UK Energy from Waste ("EfW") sector brings together data, primarily the Annual Performance Reports ("APR") submitted by operators to their respective regulator into a single, readily accessible document. We are very grateful to the continued co-operation from all concerned in releasing this information on a timely basis and their assistance in filling any gaps in the information which arise.

For consistency with previous years, the focus of this report continues to remain upon facilities in the UK generating energy solely from the combustion of Residual Waste. For the first time, however, Appendix 1 details the total tonnage of Residual Waste, in the form of Solid Recovered Fuel ("SRF"), sent to UK cement and lime kilns in 2021.

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.

Aided by the standardised APR data template, the quality of data reporting continues to improve. However there remain three areas where the quality of data remains patchy – CO_2 emissions (as reported in the Pollution Inventory), Net Calorific Value and the application of the correct units in reporting the use of consumables. With the increased focus on carbon emissions, over time the first two metric are likely to become increasingly important.

Please also note, where applicable, prior year data has been updated to reflect the latest available information and to ensure consistency on a year-to-year basis. Note also that data tables may not add up to the total due to rounding.

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CONTENTS

Front Cover Image: Rookery South EfW, fully operational in early 2022 Courtesy: Covanta Energy

1. SUMMARY OBSERVATIONS

Key Metrics

Residual Waste Processed	↑ 5.5%	Power Exported to Grid	↑ 11.2%	Average Availability	↓ 1.2%
No. of Fully Operational EfWs	53	Total Heat Exported	↑ 11.8%	Net CO_2 Impact / Tonne Input	↑ 2.1%

Figure 1: Comparison of 2021 vs 2020

Despite a second calendar year influenced by the pandemic and associated lockdowns, in 2021 the UK's EfW fleet continued to demonstrate its ongoing resilience. 14.9Mt of Residual Waste was processed in 2021, an increase of 0.8Mt on 2020, with power exports of 8.6TWh (just under 3% of UK total generation) and heat exports of 1.8TWh.

For the first time inputs of Residual Waste from Local Authorities dropped below 80%, to 77%, as Residual Commercial and Industrial ("C&I") Waste continued to be "re-shored" from export markets. In 2021 the modest tonnages of Clinical Waste accepted at UK EfWs remained largely stable. For the first time data suggests that the Net Calorific Value ("NCV") rose modestly – although only time will tell if this is part of a longer term trend.

Carbon Tax and EfW

The last 12 to 18 months have seen extensive Government consultation on waste policy in the UK – including consultations on Collections & Packaging Reform ("CPR"), Extended Producer Responsibility ("EPR"), Deposit Return Schemes ("DRS"), Plastics Tax and consultations on Environmental Targets (arising from the 2021 Environment Act) and on Landfill Tax.

However, the potentially most significant development for the UK EfW sector has been the consultation, released in March 2022, considering the extension of the UK Emissions Trading Scheme ("ETS") to EfWs from the "mid to late 2020s". This sits alongside a Government aspiration that biodegradable waste to landfill cease in 2028 and a range of developing policies and support around Carbon Capture and Storage ("CCS").

At the time of writing the details of how an extension of ETS to EfW would operate are far from clear. Assuming the proposal is implemented, for the very first time in the UK those EfWs with the lowest environmental impact (in this case in the form of carbon emissions) could be at a commercial advantage when compared with others in the market. In principle this must be a good thing.

However, in implementing such a policy, great care will be needed to ensure that the market is not distorted in unintended ways. Encouragingly, the consultation identified the need to consider the consequences of new policy on UK EfW's competition with landfill and Residual Waste exports.

There are also risks associated with over complication. Tolvik is firmly of the opinion that, at least initially, scheme design and implementation must be both clear and visible. Many EfWs have a complex network of stakeholders, including Local Authorities, waste producers (possibly including EPR schemes), waste collectors, aggregators, and funders. In the absence of clarity, there is a real risk of dispute with corresponding cash flow delays as EfW operators seek to pass back ETS related costs equitably and on a timely basis to their waste suppliers.

Care is also required to ensure policy avoids driving additional (and probably unneeded) EfW capacity in those geographies with access to future CCS solutions. This may be justifiable if the new EfW is more efficient than existing infrastructure - but it seems harder to justify if, as a consequence, Residual Waste is being transported significant distances to a CCS connected EfW for no benefit other than to potentially accelerate the exhaustion of (what may be finite) carbon storage capacity.

2. MARKET OVERVIEW

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

As at December 2021 there were 53 fully operational EfWs in the UK with three EfWs in late stage commissioning, two of which entered full operations in January 2022. During 2022 one EfW was mothballed.

The Total Permit Capacity of those EfWs which were fully operational or in late stage commissioning was 17.31Mtpa with a further 4.37Mtpa of EfW capacity either in construction or about to commence construction.

Mtpa	Fully Operational	In Late Stage Commissioning	Permit Capacity	In Construction	Total Permit Capacity
2017	11.90	0.41	12.26	3.64	15.90
2018	12.48	1.08	13.56	3.32	16.88
2019	14.65	0.66	15.31	3.10	18.41
2020	16.27	0.23	16.50	3.88	20.37
2021	16.37	0.94	17.31	4.37	21.67

Figure 2: Headline Capacity (as at December 2021) Source: Tolvik analysis

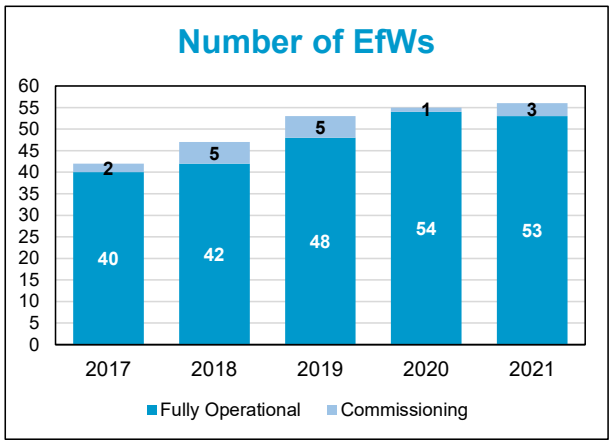

Figure 3: Number of UK EfW Facilities

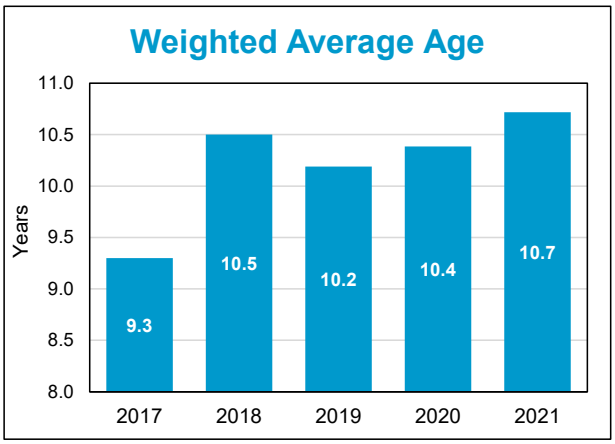

Figure 4: Weighted Average Age by Capacity (as at December 2021) Source: Tolvik analysis

Figure 4 shows the capacity-weighted average age of UK EfWs – as can be seen over the last 4 years the average age has been maintained at 10-11 years as new EfWs have become operational at a sufficient rate to maintain the average.

In time the average age will start to rise slowly as the proportion of new EfW capacity becoming operational to existing capacity will inevitably decline.

3. WASTE INPUTS

According to data provided, in 2021 a total of 14.85Mt of Residual Waste was processed in UK EfWs, an increase of 5.5% when compared with the revised 2020 total.

Total inputs were the equivalent, for EfWs fully operational throughout 2021, to 89.0% of the Permit Capacity – broadly similar to the figure for previous years.

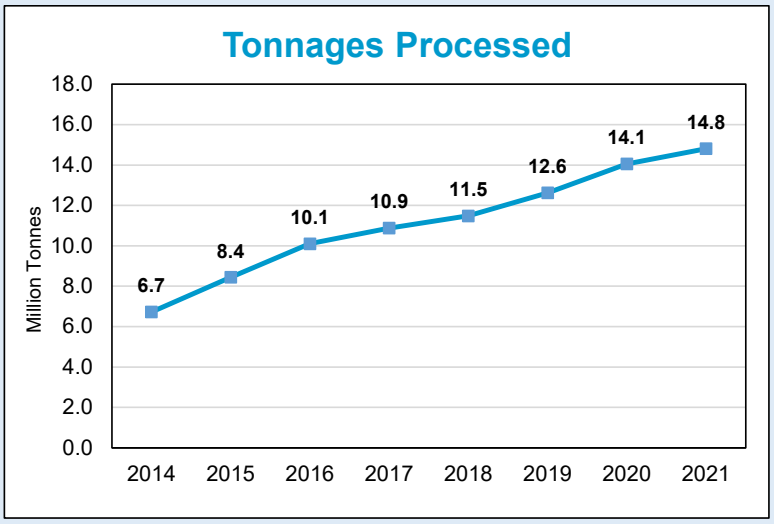

Figure 5: Total Tonnage of waste accepted at EfWs in 2014-2021 Source: APR

Mt	Input Tonnage	Annual Increase
2017	10.88	7.7%
2018	11.49	5.6%
2019	12.63	9.9%
2020	14.07	11.4%
2021	**14.85**	**5.5%**

Figure 6: Annual EfW Inputs
Source: APR

The Role of EfW in the UK Residual Waste Market

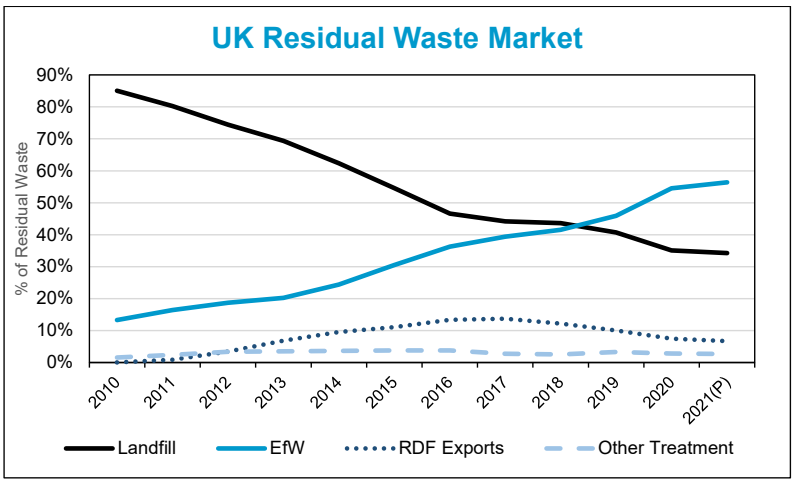

Figure 7: Development of the UK Residual Waste Treatment Source: Tolvik analysis

It is estimated that in 2021 EfW inputs represented 56% *(2020:52%)* of the UK Residual Waste market.

EfW Inputs by Waste Source and Code

Based on a detailed review of APRs for 2021 and Wastedataflow[1] for 2020/21 and other available data, it is estimated that in 2021 77.0% of all EfW inputs were derived from Residual Local Authority Collected Waste ("LACW") with the remainder being C&I Waste.

The trend of an increasing proportion of Residual C&I Waste inputs is expected to continue over the next few years as more "merchant" EfW capacity in the UK becomes operational.

Year	Waste Source		EWC Code		
	LACW	C&I Waste	20 03 xx	19 12 10/12	Other Codes
2018	82.4%	17.6%	68.9%	28.2%	2.9%
2019	81.5%	18.5%	63.4%	34.4%	2.3%
2020	80.1%	19.9%	62.0%	37.0%	1.0%
2021	**77.0%**	**23.0%**	**N/A**	**N/A**	**N/A**

Figure 8: Inputs by Waste Source Source: Wastedataflow, APR, Waste Data Interrogator[2]

According to available data, 62.0% of inputs to EfWs in 2020 was unprocessed Municipal Waste with a further 37.0% of inputs being Residual Waste arising after prior treatment.

In 2021, 38kt (*2020: 35kt*) of Clinical Waste was reported by operators as being processed by EfWs – an estimated 10% of Clinical Waste generated in the UK in 2021.

Net Calorific Value of Residual Waste

A detailed analysis in 2017 by Tolvik of data relating to the Net Calorific Value of waste (from a variety of sources, some of which was under confidentiality) suggested that the average NCV for Residual LACW was 8.87MJ/Kg and for Residual C&I Waste it was 11.01MJ/Kg.

In 2021, 32 facilities provided NCV data within their APR, although the quality of the NCV reporting was mixed.

Considering only those facilities primarily designed to accept untreated waste under 20 03 xx codes, the weighted average NCV for all inputs was 9.62MJ/kg *(2020: 9.11MJ/kg)* with those facilities reporting their NCV in total accepting 83.5% LACW and 16.5% C&I Waste.

Whilst 2020 NCV data was entirely consistent with the 2017 analysis; had this remained the case in 2021 the weighted average NCV for all inputs would have been 9.22MJ/Kg.

The implication of the most recent data is that, on a like-for-like basis, **average NCVs were 4.3% higher in 2021 than 2017**. Evidence, for example, from Germany, has shown average NCV across a number of EfWs typically fluctuates year-to-year. Given that this is data from a single year, it is therefore too early to infer that, on average across the UK, the NCV of Residual Waste is rising. It will, however, continue to be monitored.

Operator Market Shares

Viridor continues to have the greatest market share by operator based on input tonnages. MESE, MVV and Amey are not shown in the table, but each had a share of 2-3%.

Operator	2021 Input (kt)	Share
Viridor	3,203	21.6%
Veolia	2,401	16.2%
Suez	2,246	15.1%
enfinium	2,044	13.8%
FCC	1,510	10.2%
Council	830	5.6%
Cory	782	5.3%
Other	1,831	12.3%
Total	**14,846**	**100.0%**

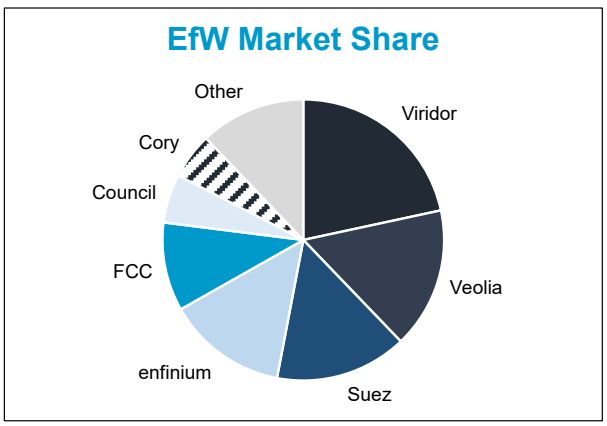

Figure 9: 2021 Share of Input Tonnage (includes Joint Ventures) Source: Tolvik analysis

4. ENERGY

It is estimated that the total power exported by EfWs in the UK in 2021 was 8,643GWh – approximately 2.9% of total net UK generation of 295,812 GWh[3].

	Est. Gross Power Generation GWh_e	Power Export GWh_e	Parasitic Load (excl. power import)	Parasitic Load (incl. power import)	Average Export kWh/tonne input	Net Heat Export GWh_{th}
2017	7,228	6,258	13.4%	14.1%	575	865
2018	7,150	6,230	12.9%	13.9%	542	1,112
2019	7,769	6,703	13.7%	16.2%	531	1,384
2020	9,002	7,769	13.7%	15.5%	553	1,651
2021	**10,060**	**8,643**	**14.1%**	**16.2%**	**591**	**1,845**

Figure 10: 2021 Power Generation Source: Tolvik analysis

2021 saw a further significant improvement in power export per tonne of waste inputs following the 2019 low during which a number of EfWs suffered from significant turbine issues.

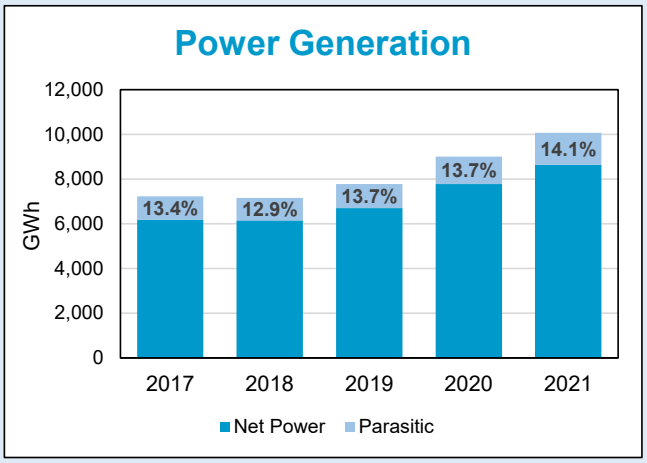

Figure 11: Power Generation from EfW

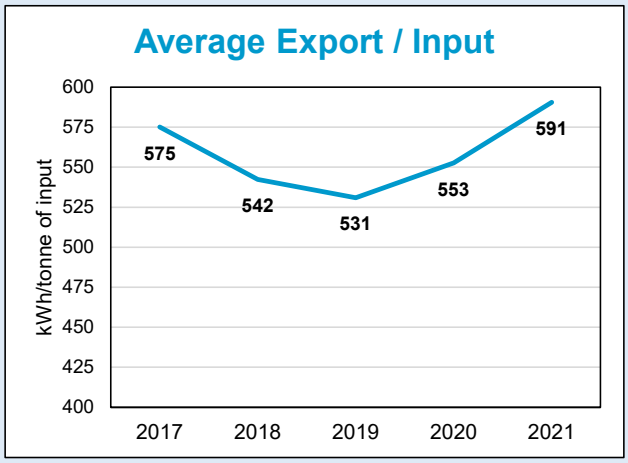

Figure 12: Average Power Export per tonne of input

Power: Benchmarking

For each EfW for which data was reported, Figures 13 and 14 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 591kWh/t generated per tonne of waste input in 2021 *(2020: 553kWh/t),* across all EfWs the output ranged from 197kWh/t to 949kWh/t.

The average parasitic load figures are to some extent impacted by those EfWs, particularly Advanced Conversion Technology ("ACT") facilities, which also undertake some pre-processing of waste prior to combustion. Such facilities account for the three highest parasitic loads in Figure 14. Excluding ACTs, in 2021 the average parasitic load was 13.8%.

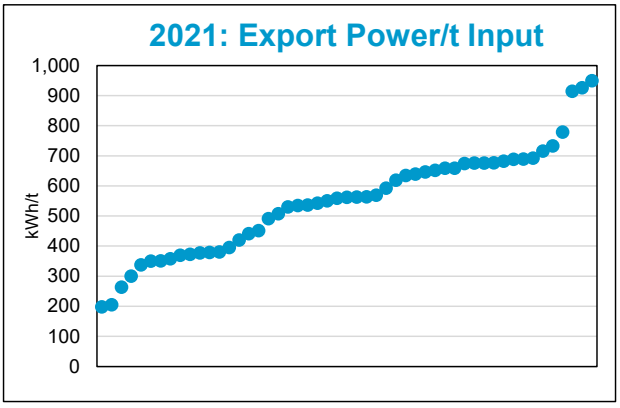

Figure 13: 2021 Net Power Exported per tonne of Input
Source: Tolvik analysis, 51 records

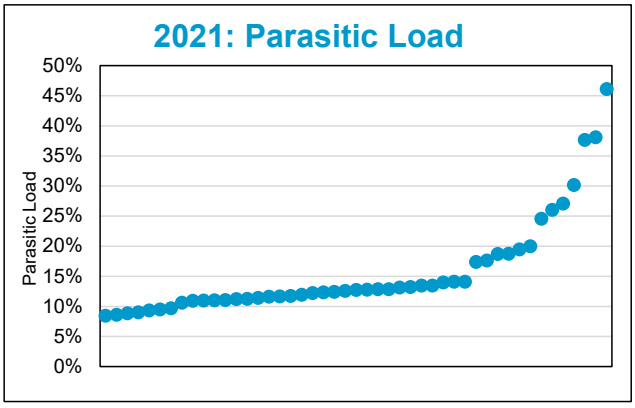

Figure 14: 2021 Parasitic Load Distribution
Source: Tolvik analysis, 47 records

Beneficial Heat Use

In 2021,12 EfWs in the UK exported heat for beneficial use alongside power with an estimated total export of 1,845GWh$_{th}$. *(2020: 1,651GWh$_{th}$)*. Across all EfWs this was the equivalent of 125kWh$_{th}$/tonne of inputs *(2020: 117kWh$_{th}$/tonne)*.

EfW	Est. Export GWh$_{th}$				
	2017	2018	2019	2020	2021
Runcorn	405	408	405	480	616
Eastcroft	224	332	420	405	390
Wilton 11	-	100	303	373	332
Kemsley	-	-	-	123	235
Sheffield	96	112	111	95	98
Devonport	54	59	48	54	54
Gremista	40	40	40	50	42
SELCHP	37	38	39	40	44
Leeds	-	8	2	14	16
Coventry	5	11	13	8	12
NewLincs	3	3	3	7	3
Edmonton	-	-	-	2	2
Total	**865**	**1,112**	**1,384**	**1,651**	**1,845**

Figure 15: Reported Heat Exports from EfWs Source: APR

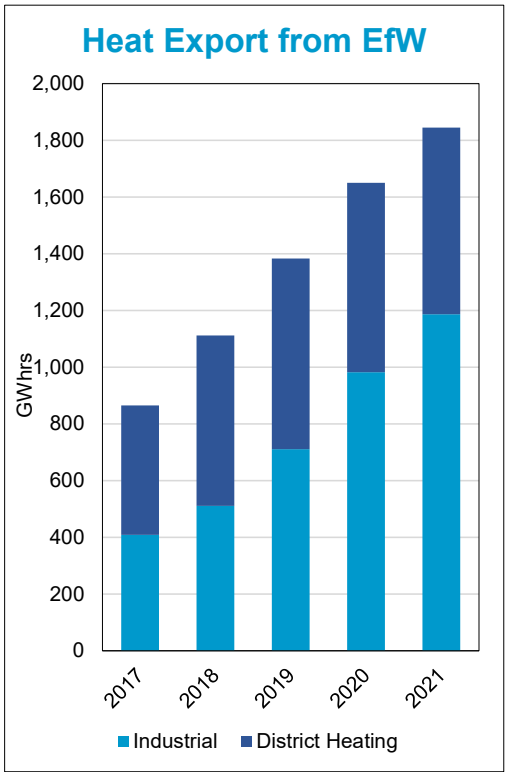

Figure 16: Heat Exports by Demand Source: APR

5. OPERATIONS

Across those EfWs which were operational for the whole of 2021, the weighted average availability based on waste combustion hours was 88.6% *(2020: 89.8%)*. The simple average availability based on turbine operational hours was lower at 84.0% *(2020: 85.9%)*.

Figure 17 also shows ash generation and metals recovery were relatively steady.

	Availability - Hours			% of Input Tonnage		
	Waste Combustion - Simple Average	Waste Combustion – Weighted Average	Turbine Operations – Simple Average	Incinerator Bottom Ash ("IBA")	Air Pollution Control Residue ("APCr")	Metals Recovery (if reported)
2017	88.6%	89.3%		20.1%	3.4%	1.9%
2018	87.3%	89.8%		19.9%	3.3%	1.9%
2019	89.5%	90.0%	81.9%	19.4%	3.3%	1.9%
2020	89.2%	89.8%	85.9%	19.8%	3.1%	1.9%
2021	**85.7%**	**88.6%**	**84.0%**	**19.8%**	**3.2%**	**1.7%**

Figure 17: Operational Data Source: APR

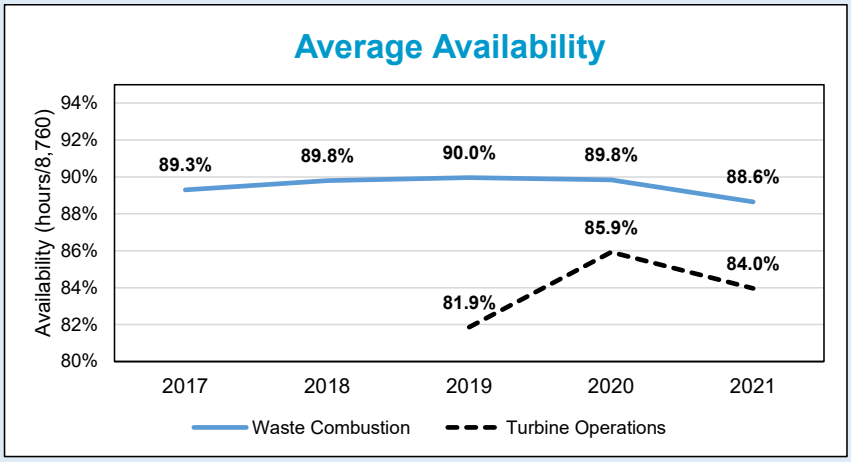

Figure 18: Average EfW Availability – Hours Source: Tolvik analysis

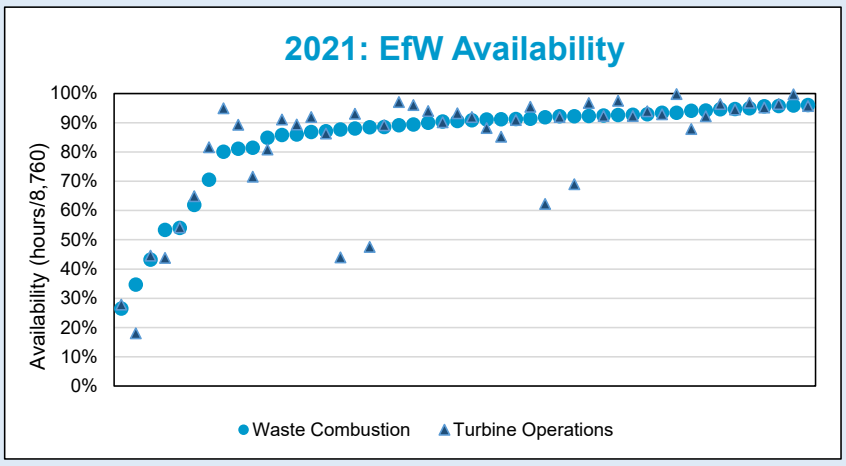

Figure 19: 2021 EfW Availability – Hours Source: Tolvik analysis, 53 records

As Figure 19 shows, during 2021 there was significant variation across EfWs in availability as measured by waste combustion hours - ranging from a low of around 26% to a high of over 99%. For the six reporting ACT facilities, average availability during 2021 was 48.5% with a high of 70.5%.

Excluding these ACT facilities, the average weighted average availability for waste combustion was 90.6% - i.e. 2.0% higher than that shown in Figure 17.

Operator	Number of EfWs reporting	Simple Average Availability	Capacity Weighted Average
Veolia	10	95.1%	94.3%
enfinium	4	92.3%	93.0%
Viridor	10	89.1%	91.2%
MESE	3	90.6%	90.0%
Cory	1	89.1%	89.1%
Suez	7	85.1%	89.1%
Public Sector	3	84.5%	89.0%
FCC	6	89.5%	88.0%
MVV	2	85.0%	85.7%
Amey	2	73.4%	81.1%
Other	5	71.5%	79.9%
Total	**53**	**85.7%**	**88.6%**

Figure 20: 2021 Average Availability (Waste Combustion) by Operator – EfWs operational for the full year

Outputs

Incinerator Bottom Ash

In 2021 IBA accounted on average for 19.8% *(2020: 19.8%)* of all waste inputs. In total, the tonnage of IBA generated in 2020 was just over 2.9Mt.

Except three ACT facilities at the lower end of the range, IBA outputs expressed as a percentage of waste inputs fell within the 11% - 27% range.

Air Pollution Control Residues

In 2021 APCr generation was 3.2% of waste inputs *(2020: 3.1%)*. Total generation of APCr in 2021 is estimated to have been 470kt with 35.6% recycled.

Six facilities generated more than 5% of APCr as a percentage of inputs – being those EfWs using fluidised bed technology, ACTs and one small EfW. Two EfWs generated less than 2% of APCr.

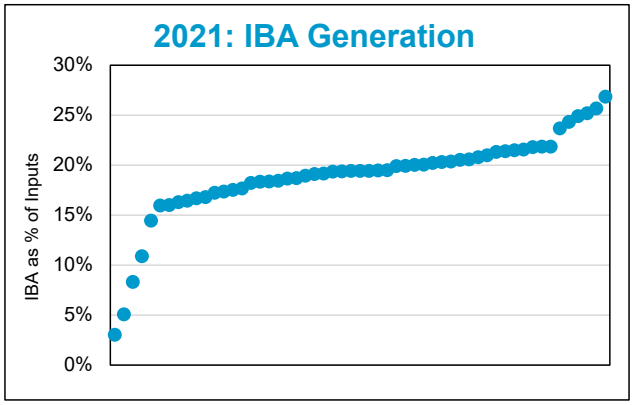

Figure 21: 2021 Distribution of IBA Generation (as % of inputs)
Source: Tolvik analysis, 51 records

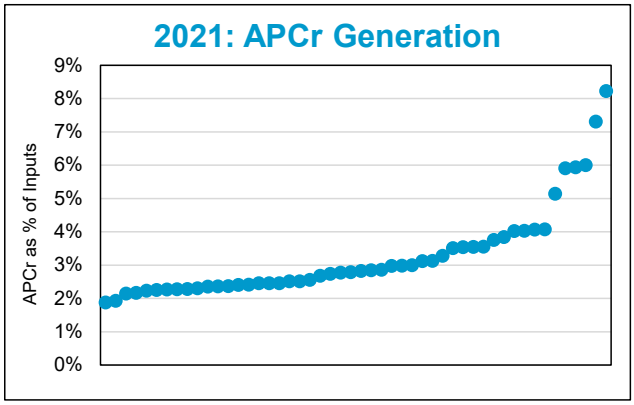

Figure 22: 2021 Distribution of APCr Generation (as % of inputs)
Source: Tolvik analysis, 51 records

Consumable Use

The analysis in this section is calibrated to "Specific Usage" i.e. usage per tonne of waste input. There have been no longer term trends which are discernible with respect to any of the consumables.

Consumable	Per tonne input	Low	Median	High
Total Water Usage	m^3	0.02	0.20	6.25
Activated carbon or coke	kgs	0.07	0.29	1.41
(Hydrated) lime or sodium bicarb	kgs	1.05	10.14	36.55
Urea	kgs	0.37	1.33	5.44
Ammonia	kgs	0.36	1.54	13.40
Fuel Oil	ltrs	0.04	1.42	81.36

Figure 23: 2021 Specific Consumable Usage (where reported) Source: APR

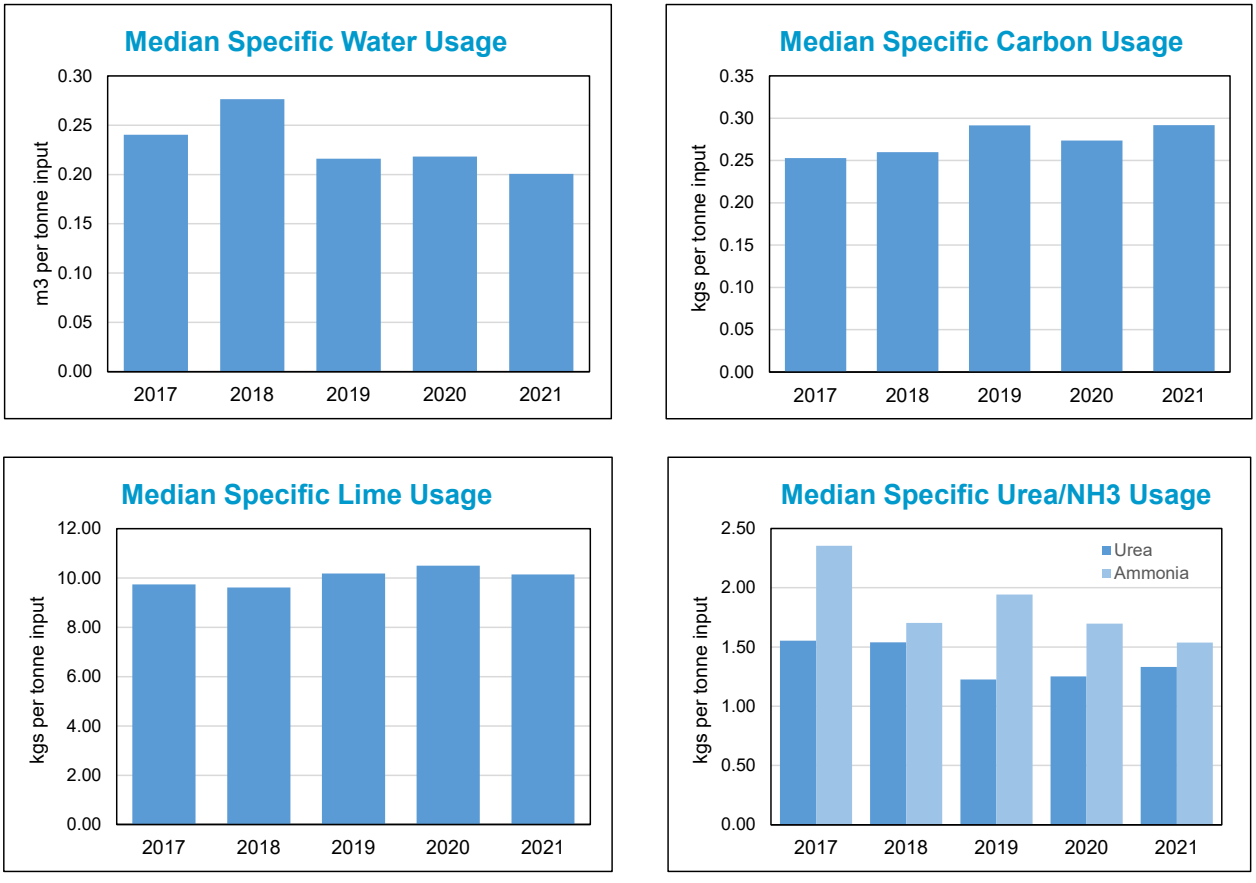

Figure 24: Trends in Specific Consumable Usage (where reported) Source: APR

R1 Energy Efficiency Status

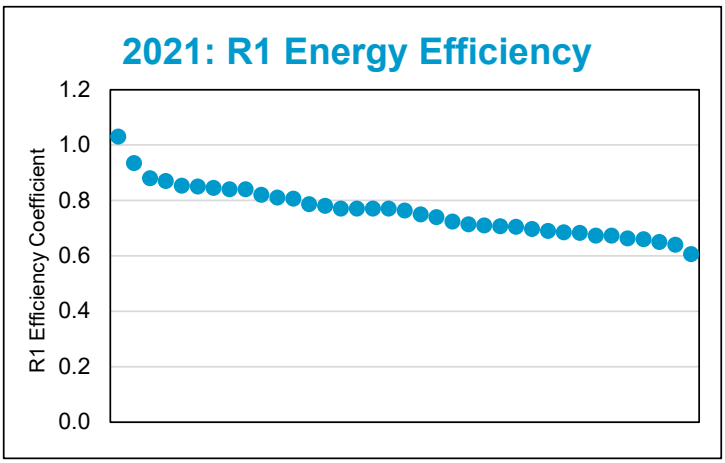

Figure 25: R1 Energy Efficiency Status Source: EA, APRs

As at April 2022, based on EA data and information in the APR, 37 EfWs with a total headline capacity of 12.8Mt were accredited as R1 ("Recovery") operations.

19 EfWs that were fully operational in 2021 do not have R1 status and are therefore classified as "Disposal" operations.

To achieve R1 requires an efficiency coefficient of at least 0.60 (for pre 2009 EfWs) and 0.65 (for new EfWs).

Carbon Intensity of EfW (per tonne)

It continues to be the case that, in the absence of a standard methodology, there is a significant element of subjectivity in estimating carbon intensity of EfW. This is further complicated by the wide variation in the operational performance of individual EfWs and the range of wastes accepted.

There is a general consensus that EfWs are not simply power stations and that it is incorrect to benchmark them solely against other sources of power generation. The general view is that any estimate of carbon intensity needs to also recognise their role in diverting Residual Waste from landfill and, depending on their operational configuration, generating heat and power and contributing to recycling.

The analysis of carbon intensity is very sensitive to the estimates given as to the total tonnage of CO_2 emitted by each EfW. As previously, we have based our data on Pollution Inventory returns. There are indications in the latest available data, which relates to 2020, that operators have reconsidered the basis of their submissions. As a result there is limited merit in analysing year-on-year trends as they do not appear directly comparable.

As Figure 26 shows, there continues to be is a very significant variation in reported CO_2 emissions. It seems highly unlikely that actual emissions from EfWs range by the 540% indicated by reported data. Further work is needed to ensure consistent calculation methodology and reporting.

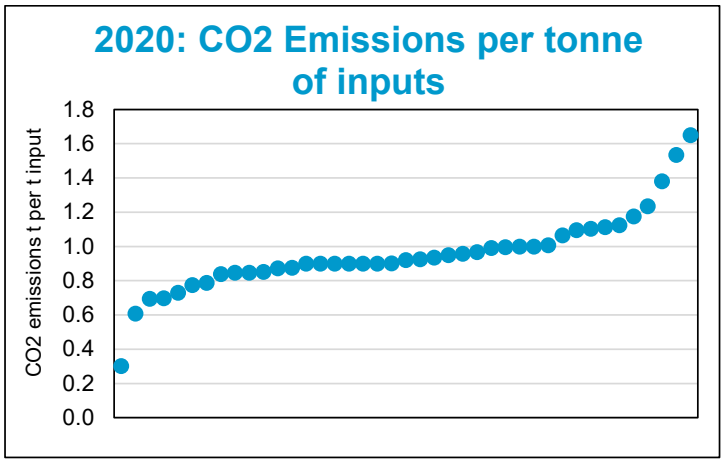

Figure 26: CO_2 emissions per tonne of inputs Source: Pollution Inventory[4]

In 2021 there were improvements in both power and heat exports with a combined c.7% increase from 663kWh per tonne of waste to 709kWh/t. However, the rate of decarbonisation of UK energy generation, particularly in the power sector, was greater (at around 10%). As a result, **despite efficiency improvements, the carbon benefit from power and heat generation deriving from the UK EfW fleet continued to fall** (by just over 3%).

Excluding any benefits from avoiding landfill, it is estimated that in 2021, on average across the UK fleet, net carbon emissions were 0.340 tCO_2e per tonne of waste, up 2.1% on the recalculated 0.333 tCO_2e per tonne of waste seen in 2020.

	Per tonne of Input Waste	Unit	Data Source	2020	2021
	Average CO_2 emitted	*tCO_2*	*2020 Pollution Inventory[4]*	*0.992*	*0.992*
	% Fossil		*WRAP Composition – 2017[5]*	*47.9%*	*48.0%*
Emissions	Fossil CO_2 emitted	tCO_2		0.475	0.476
	Other GHG emitted	tCO_2e	*N_20 from Pollution Inventory[4]*	0.037	0.037
	Fuel import	tCO_2e	*APR and UK GHG Conversion Factor*	0.007	0.007
	Total Fossil Emissions	**tCO_2e**		**0.519**	**0.520**
EfW Outputs	*Total Power Export*	*MWh*	*Figure 10*	*0.553*	*0.591*
	Imported Power	*MWh*	*APR*	*(0.007)*	*(0.006)*
	Net Power Export	*MWh*		*0.546*	*0.584*
	Heat Export	*MWh*	*Figure 15 text*	*0.117*	*0.125*
	Recycling Benefit	*t*	*Figure 17*	*0.019*	*0.017*
Substitution Benefits	Net Power Export	tCO_2e	*Converted using UK Government GHG Conversion Factors for company reporting for the applicable year[6]*	(0.127)	(0.124)
	Heat Export	tCO_2e		(0.020)	(0.021)
	Recycling Benefit	tCO_2e		(0.039)	(0.034)
	Total Benefits	**tCO_2e**		**(0.186)**	**(0.180)**
	Impact (Net Emissions)	**tCO_2e**		**0.333**	**0.340**

Figure 27: Estimated Carbon Emissions per tonne of waste input

6. COMPLIANCE

Compliance in the EfW sector is a combination of operator self-monitoring, reporting to and monitoring by the relevant regulator.

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.

Operators advise that measurement uncertainty, limits of detection for small samples and impact of background pollutant levels can all affect the analysis, but the protocols used by the sector should be such that reported results are effectively a worst case.

Across all continuously monitored emissions to air, on average in 2021 emissions were 28.4% of the Emission Limit Value ("ELV") *(2020: 29.1%)*. Meanwhile, for periodically monitored emissions, on average emissions were 8.6% of ELV *(2020: 8.1%)*.

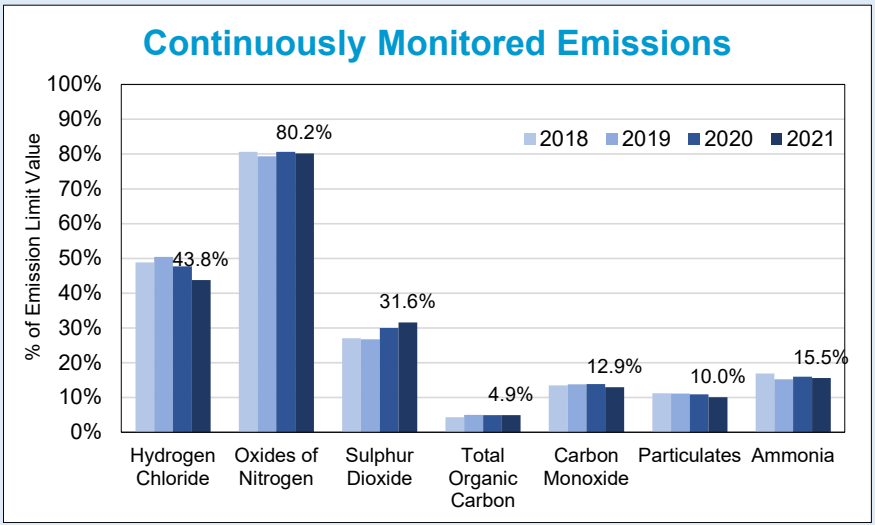

Figure 28: Continuously Monitored Emissions to Air Source: APR

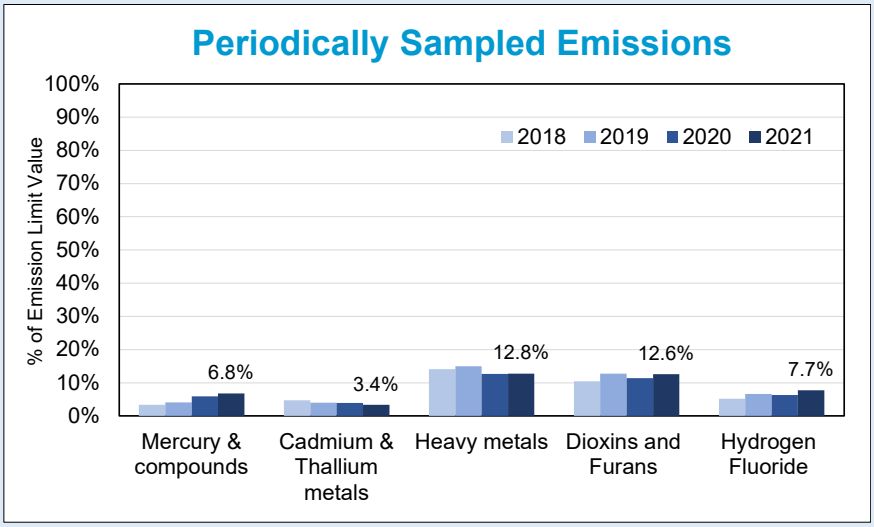

Figure 29: Periodically Monitored Emissions to Air Source: APR

It is to be noted that emission levels of Hydrogen Chloride (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.

There have been no discernible trends in continuously monitored emissions to air over the last 4 years.

However, as Figure 30 shows, based upon the last 5 years of data, for most substances that are continuously monitored, in general newer EfWs operate at slightly lower emission levels than older facilities.

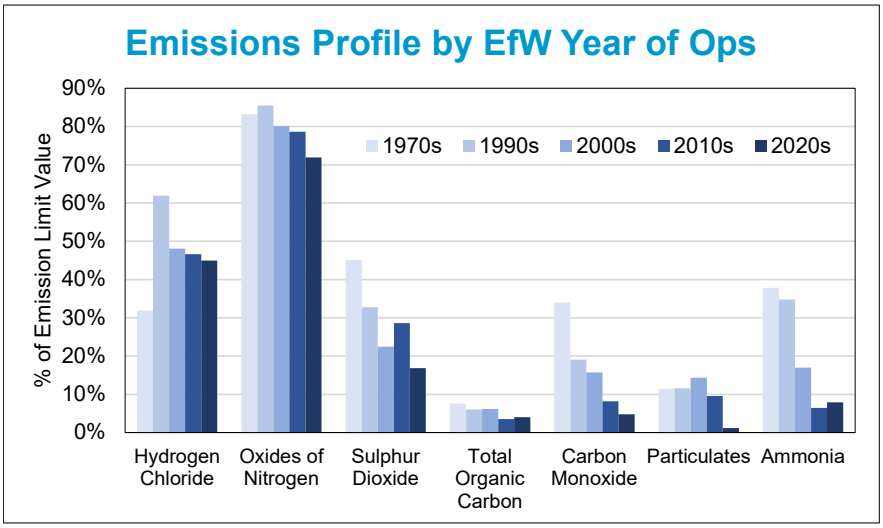

Figure 30: Continuously Monitored Emissions to Air – by First year of EfW Operation Source: APR

Abnormal Operations

Abnormal Operations	Unit	Year	Total	Number of EfWs Reporting	Per EfW
Abnormal Hours	Hours	2018	130	38	3.4
		2019	96	42	2.3
		2020	168	48	3.5
		2021	**120**	**52**	**2.3**
Abnormal Events	Instances	2019	87	44	2.0
		2020	72	48	1.5
		2021	**101**	**51**	**2.0**
Permit Breaches	Instances	2019	127	39	3.3
		2020	148	47	3.1
		2021	**139**	**50**	**2.8**

Figure 31: Abnormal Operations Source: APR

In 2021 one facility reported abnormal operations for 57% of the year. This facility has been excluded from Figure 31 as it materially distorts the overall performance of UK EfWs.

As in previous years, in 2021 five different EfWs reported more than 10 permit breaches and together accounted for 52% of all breaches.

7. CAPACITY DEVELOPMENT

Based on EfWs which were operational or in construction as at December 2021, Section 2 identifies the total Permit Capacity of 21.7Mtpa.

Permit Capacity is not suitable for projecting future EfW capacity in any analysis of the UK Residual Waste market – as EfWs generally do not operate at this level. "Operational Capacity" is a more appropriate measure; it is estimated (based upon the EfWs listed in Appendix 1, that by 2026 the UK Operational Capacity will be **19.4Mtpa.**

Figure 32 also shows historic Residual Waste tonnages in the UK – including a preliminary estimate for 2021. It does not show the projected Residual Waste tonnages, as such projections involve consideration of a number of factors outside the scope of this report.

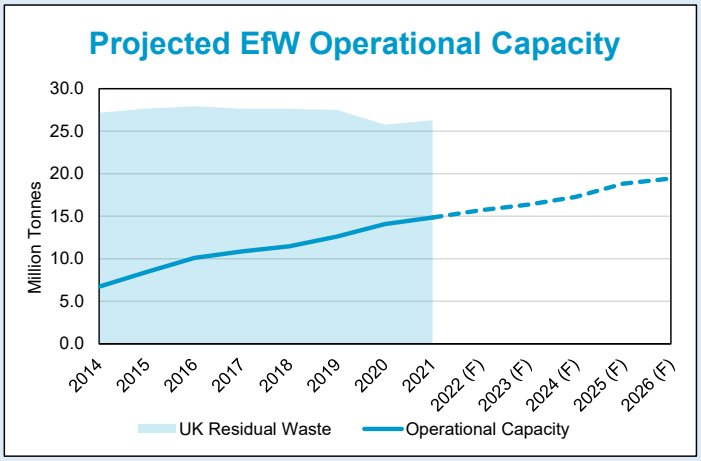

Figure 32: Projected UK EfW Operational Capacity Source: Tolvik analysis

EfW in Development – Additional Capacity

The Operational Capacity beyond 2026 will be dependent on the extent of development of new additional EfWs. Tolvik's database of active development projects has reversed previous trends as a number of projects have reached financial close, seemingly ceased being progressed, been cancelled and/or have been refused consent.

As Figure 33 shows, this suggests that fewer new projects are now being actively brought forward which is likely to reflect challenges in securing suitable waste supply commitments and also a construction market that is somewhat constrained at present.

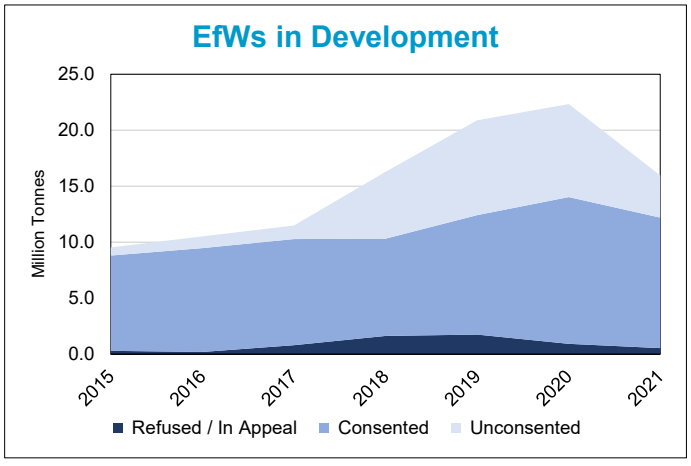

Figure 33: Historic EfW Capacity in Development

APPENDIX 1: ENERGY FROM WASTE FACILITIES INCLUDED IN THE REPORT

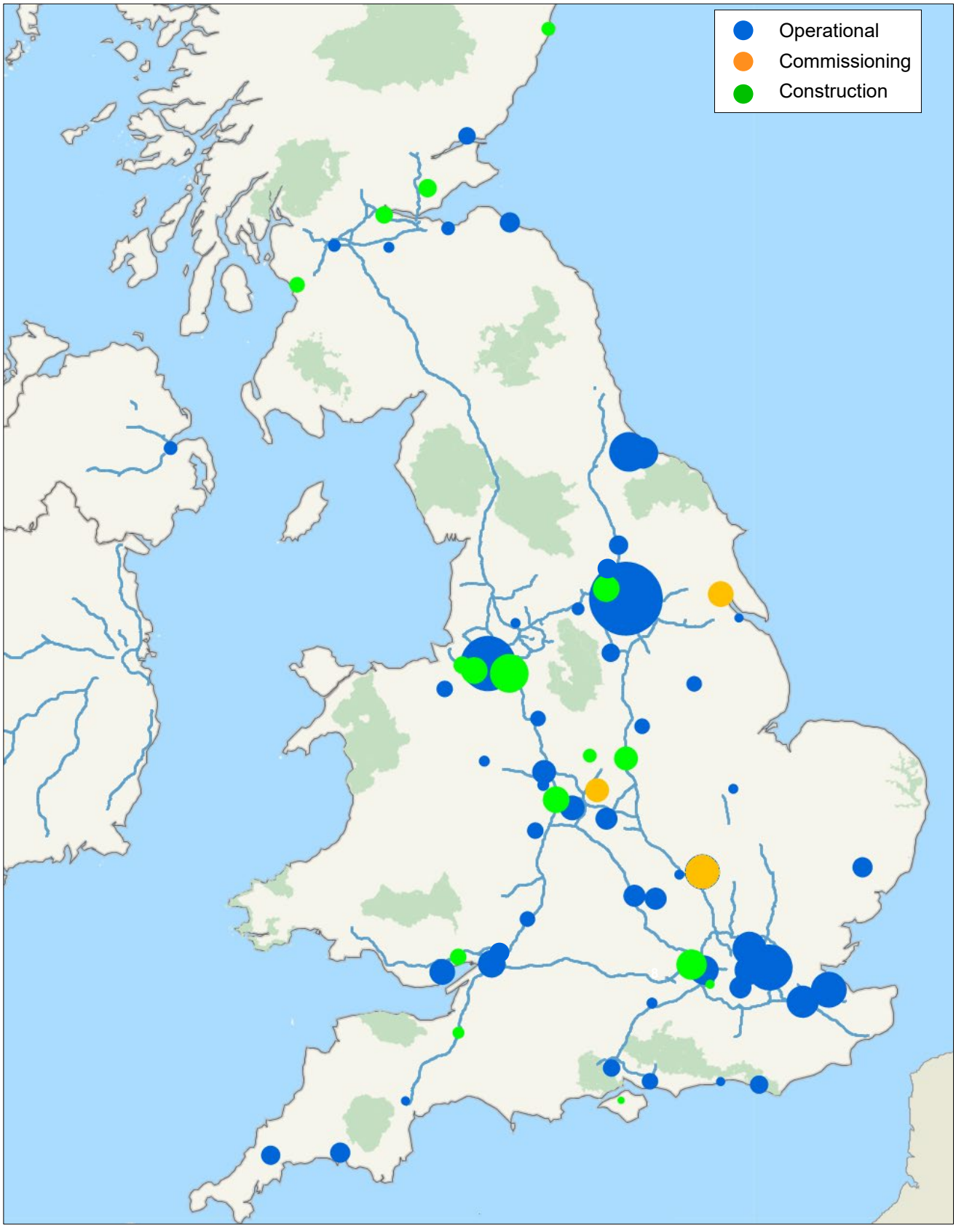

Figure 34: Location of EfW facilities (for further details on the EfWs shown see Figures 35-38)

Operational EfWs

	Permitted Name	Known As	Location	Operator	Permit Capacity (ktpa)	Processed (ktpa)		
						2019	2020	2021
1	Runcorn EfW Facility	Runcorn	Halton	Viridor	1,100	962	943	957
2	Riverside Resource Recovery Facility	Riverside	Bexley	Cory	785	743	731	782
3	Tees Valley - EfW Facility	Tees Valley	Stockton-on-Tees	Suez	756	651	682	675
4	Ferrybridge Multifuel 1	Ferrybridge FM1	Wakefield	enfinium	725	667	599	656
47	Ferrybridge Multifuel 2	Ferrybridge FM2	Wakefield	enfinium	725	129	615	669
51	Kemsley Park EfW	Kemsley	Kent	enfinium	657		410	527
5	Edmonton EcoPark	Edmonton	Enfield	Council	620	498	542	516
6	Allington Waste Management Facility	Allington	Kent	FCC	560	488	423	472
9	Wilton 11 EfW	Wilton 11	Middlesborough	Suez	500	448	470	459
12	Severnside Energy Recovery Centre	Severnside	S.Gloucestershire	Suez	467	397	411	402
7	SELCHP ERF	SELCHP	Lewisham	Veolia	464	439	369	434
8	Lakeside EfW	Lakeside	Slough	Lakeside	450	427	420	382
11	Tyseley ERF	Tyseley	Birmingham	Veolia	441	343	363	375
10	Cardiff Energy Recovery Facility	Trident Park	Cardiff	Viridor	425	366	379	378
54	Severn Road RRC	Avonmouth	Bristol	Viridor	377		68	285
45	Beddington Energy Recovery Facility	Beddington Lane	Croydon	Viridor	347	279	322	320
13	Greatmoor EfW	Greatmoor	Buckinghamshire	FCC	345	295	300	303
14	Staffordshire ERF	Four Ashes	Staffordshire	Veolia	340	337	340	339
15	Ardley EfW Facility	Ardley	Oxfordshire	Viridor	326	280	290	334
43	Dunbar Energy Recovery Facility	Dunbar	East Lothian	Viridor	325	251	325	307
41	Allerton Waste Recovery Park	Allerton Park	North Yorkshire	Amey	320	255	227	287
16	CSWDC Waste to Energy Plant	Coventry	Coventry	Council	315	299	313	295
17	SUEZ Suffolk - EfW Facility	Great Blakenham	Suffolk	Suez	295	267	291	292
18	Devonport EfW CHP Facility	Devonport	Plymouth	MVV	265	265	261	243
20	Sheffield ERF	Sheffield	Sheffield	Veolia	245	230	240	228
21	Newhaven ERF	Newhaven	East Sussex	Veolia	242	223	229	229
19	Cornwall Energy Recovery Centre	Cornwall	Cornwall	Suez	240	243	237	242
25	EnviRecover EfW Facility	Hartlebury	Worcestershire	Severn	230	201	213	216
22	Integra South West ERF	Marchwood	Southampton	Veolia	220	211	204	210
23	Integra South East ERF	Portsmouth	Portsmouth	Veolia	220	195	205	200
24	Stoke EfW Facility	Hanford	Stoke-on-Trent	MESE	210	179	189	185
26	Eastcroft EfW Facility	Eastcroft	Nottingham	FCC	200	188	191	186
48	Parc Adfer ERF	Parc Adfer	Deeside	enfinium	200	58	197	192
28	Lincolnshire EfW Facility	North Hykeham	Lincolnshire	FCC	190	175	185	171
46	Millerhill Recycling and ERC	Millerhill	Edinburgh	FCC	190	142	157	161
49	Javelin Park ERF	Javelin Park	Gloucestershire	UBB	190	68	183	191
27	Leeds Recycling and ERF	Leeds	Leeds	Veolia	190	174	182	181
31	Baldovie Waste To Energy Plant	Baldovie	Dundee	MVV	175	96	92	161
44	Glasgow RREC	Polmadie ACT	Glasgow	Viridor	154	83	149	99
29	Kirklees EfW Facility	Kirklees	Huddersfield	Suez	150	134	124	134
52	Full Circle Generation EfW	Belfast ACT	Belfast	Bouygues	144	34	76	49
30	Bolton ERF	Bolton	Gtr Manchester	Suez	120	76	53	42
32	Wolverhampton EfW Facility	Wolverhampton	Wolverhampton	MESE	118	114	114	112
33	Integra North ERF	Chineham	Hampshire	Veolia	110	94	98	105
34	Dudley EfW Facility	Dudley	Dudley	MESE	105	96	98	97
35	Battlefield EfW Facility	Battlefield	Shropshire	Veolia	102	99	97	99
53	Levenseat Renewable Energy	Levenseat ACT	West Lothian	Outotec	97	20	50	50
42	Milton Keynes Waste Recovery Park	Milton Keynes ACT	Milton Keynes	Amey	94	58	66	56
36	Peterborough EfW Facility	Peterborough	Peterborough	Viridor	85	80	80	81
37	Enviropower Ltd, Lancing	Lancing	West Sussex	Enviropower	75	55	64	67
38	Exeter ERF	Exeter	Devon	Viridor	60	58	60	60
39	Integrated Waste Management Facility	NewLincs	NE Lincolnshire	Tiru	56	51	54	51
40	Energy Recovery Plant	Gremista	Shetland Islands	Council	26	21	23	19
	Other EfWs in Commissioning but not achieved Takeover					83	63	281
			Totals		**16,367**	**12,626**	**14,069**	**14,846**

Figure 35: Operational EfWs in 2021 Source: APR

EfWs In Commissioning

	Permitted Name	Known As	Location	Operator	Start Date	Permit Capacity (ktpa)	Processed (ktpa) 2020	2021
C6	Hull Energy Works	Energy Works ACT	Hull	Engie	Q1 2016	227	13	35
C14	Baddersley EfW	Baddersley	Warwickshire	Equitix	Q1 2018	130	12	40 (est)
C18	Rookery South ERF	Rookery South	C Bedfordshire	Covanta	Q1 2019	585	0	170
				Total		**942**	**24**	**244**

Figure 36: EfWs In Commissioning as at December 2021 Source: Tolvik analysis

EfWs In Construction

	Permitted Name	Known As	Location	Developer	Financial Close	Capacity (ktpa)
C5	Charlton Lane Eco Park	Eco Park ACT	Surrey	Suez	Q2 2016	60
C12	Isle of Wight EfW	Isle of Wight	Isle of Wight	Amey	Q2 2017	30
C15	Hooton Park Sustainable Energy	Hooton Park ACT	Merseyside	BWSC/Cogen	Q4 2018	266
C16	Bridgwater Resource Recovery	Bridgwater	Somerset	Equitix/Iona	Q4 2018	123
C17	Earls Gate Energy Centre	Earls Gate	Falkirk	Earls Gate	Q4 2018	236
C19	Lostock Sustainable Energy Plant	Lostock	Cheshire West	FCC	Q1 2019	600
C20	NESS EfW Facility	NESS	Aberdeenshire	Indaver/Acconia	Q3 2019	150
C21	Newhurst ERF	Newhurst	Leicestershire	Biffa/Covanta/GIG	Q1 2020	350
C22	Drakelow Energy Generation Facility	Drakelow ACT	Derbyshire	Vital	Q1 2020	170
C23		Newport	Newport	Vogen/Aviva	Q1 2020	220
C24	Protos Refuse Derived Fuel Plant	Protos	Cheshire West	Biffa/Covanta/GIG	Q4 2020	410
C25	Slough Multifuel	Slough	Slough	SSE/CIP	Q4 2020	480
C26	Skelton Grange EfW	Skelton Grange	Leeds	enfinium	Q4 2021	435
C27	Oldhall Energy Recovery Facility	Oldhall	North Ayrshire	Octopus	Q4 2021	186
C28	Kelvin Energy Recovery Facility	Kelvin Way	West Bromwich	enfinium	Q4 2021	400
C29	Westfield Energy Recovery	Westfield	Fife	Brockwell	Q4 2021	250
C30	*Edmonton EcoPark (Replacement)*	*Edmonton*	*Enfield*	*Council*	*Q4 2021*	*700*
				Total		**4,365**

Figure 37: EfWs In Construction in 2021 Source: Tolvik analysis

No additional EfW capacity reached financial close in Q1 2022.

Mothballed

	Permitted Name	Known As	Location	Last Operator	Date	Processed (ktpa) 2018	2020	2021
M1	Sinfin IWTC	Sinfin Road ACT	Derby	Renewi	Aug-19	50	0	0
M2	Hoddesdon EfW Plant	Hoddesdon ACT	Hertfordshire	BIG	Jan-22	0	39	36
				Total		**50**	**39**	**36**

Figure 38: Mothballed EfWs Source: Tolvik analysis

Co-Incinerated in Cement and Lime Kilns

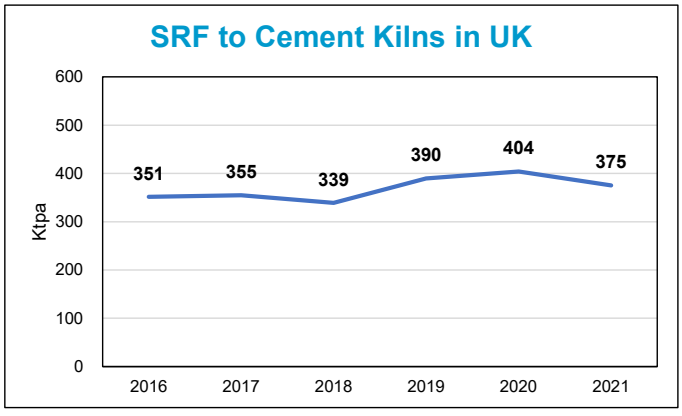

Figure 39: SRF to UK Cement and Lime Kilns Source: Tolvik analysis

In 2021 the tonnage of SRF under EWC code 19 10 12 sent to cement and lime kilns in the UK was an estimated 375kt – broadly similar to the figure over recent years. In 2021, excluding fly ash, cement and lime kilns processed circa 250ktpa of other wastes – primarily tyres and hazardous solvents (each around 100kt).

APPENDIX 2: INTERNATIONAL BENCHMARKS

EfW Capacity per Capita

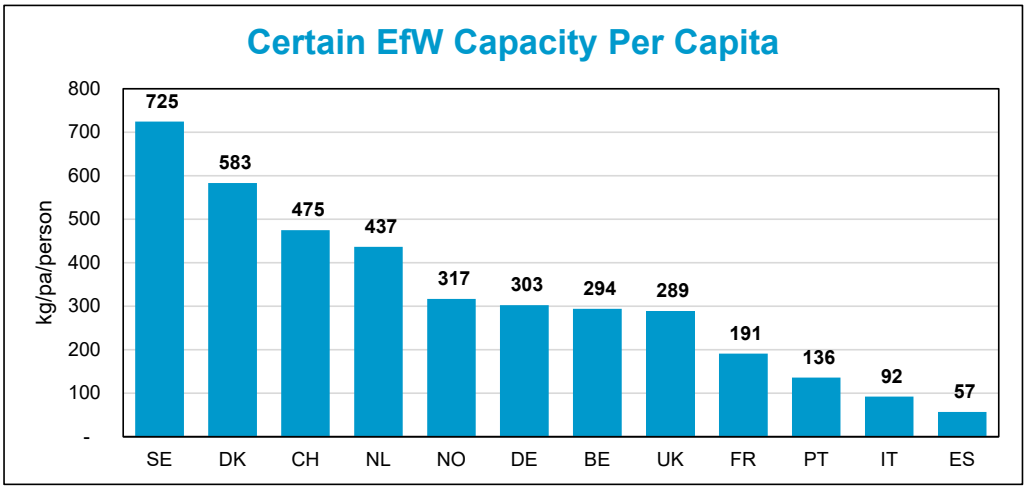

Figure 40: EfW Capacity per Capita as at March 2022 Source: Tolvik analysis

Figure 40 shows the estimated EfW capacity per person across selected European countries. The UK figure is based on the 19.4Mtpa of Operational Capacity in Section 7.

Heat and Power Generation

Figure 41 illustrates that UK EfWs are largely focussed on electricity export. Aside from Italy, where the average calorific value of waste sent to EfW is high (reportedly over 12 MJ/kg), the UK generates the greatest MWh/t of electricity per tonne of waste input.

By contrast, with the exception of Portugal and Spain, the UK exports the least heat – whether in the form of either hot water or steam.

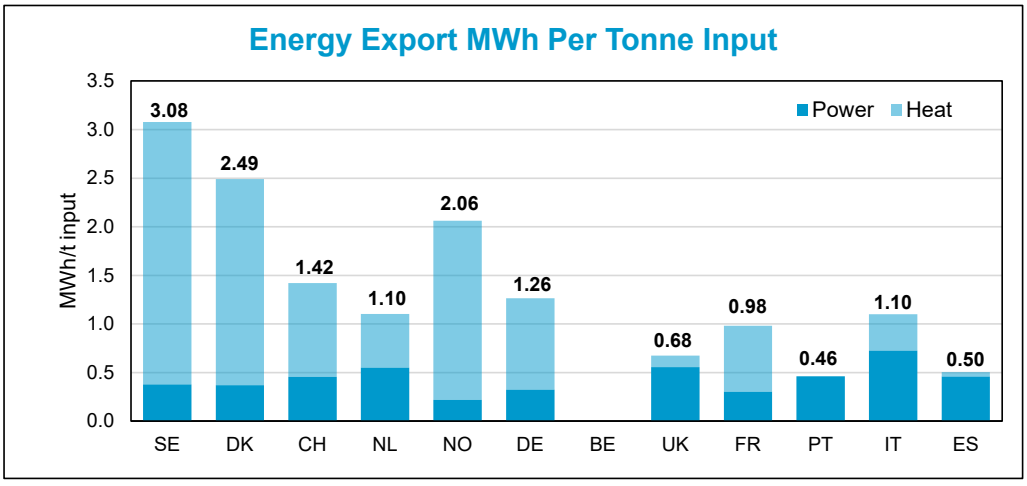

Figure 41: Energy Export per tonne of Residual Waste processed Source: Various

APPENDIX 3: DATA SOURCES

APR have either been 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. All rights reserved.

SEPA Contains SEPA data © Scottish Environmental Protection Agency and database right 2021. All rights reserved.

(1) http://www.wastedataflow.org/ Q100 for four quarters Apr 2020 – Mar 2021

(2) Environment Agency: 2020 Waste Data Interrogator
https://environment.data.gov.uk/portalstg/home/item.html?id=f4adcd438cb144f8ad2b24529bbec78f

(3) 2021 Digest of UK Energy Statistics ("DUKES") Table 5.5
https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2021

(4) 2020 Pollution Inventory Dataset – Version 2
https://environment.data.gov.uk/portalstg/home/item.html?id=9fd350cf2d264cf2967f28cb6bd5895c

(5) WRAP: National Municipal Waste Composition, England 2017
https://wrap.org.uk/content/quantifying-composition-municipal-waste

(6) https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

APPENDIX 4: GLOSSARY

ACT	Advanced Conversion Technology
APCr	Air Pollution Control residue
APR	Annual Performance Reports
C&I	Commercial and Industrial Waste
CCS	Carbon Capture and Storage
EA	Environment Agency
EfW(s)	Energy from Waste (facilities)
ELV	Emission Limit Value
ETS	Emissions Trading Scheme
EWC	European Waste Catalogue
IBA	Incinerator Bottom Ash
Kt (pa)	'000s tonnes (per annum)
LACW	Local Authority Collected Waste
Mt (pa)	Million tonnes (per annum)
NCV	Net Calorific Value
NIEA	Northern Ireland Environment Agency
NRW	Natural Resources Wales
RDF	Refuse Derived Fuel
Residual Waste	Solid, non-hazardous, combustible waste which remains after recycling either treated (in the form of RDF or SRF) or untreated (as "black bag" waste).
SEPA	Scottish Environmental Protection Agency
SRF	Solid Recovered Fuel

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MARKET ANALYSIS

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