TOLVIK CONSULTING

The Waste and Bioenergy Experts

UK Energy from Waste Statistics – 2020

May 2021

INTRODUCTION

Tolvik's seventh annual report on the UK Energy from Waste ("EfW") sector brings together data from a range of sources into a single, readily accessible document. We are very grateful to the continued co-operation from all concerned, in particular the Environment Agency ("EA"), Environmental Services Association and individual EfW operators, with data analysis greatly helped by the new Annual Performance Report ("APRs") formats.

Building upon last year's report, the section on carbon intensity of EfW has been expanded. As in previous years we welcome any feedback on the report as a whole but we are particularly interested in comments on what is becoming an increasingly significant section.

For consistency with previous years, the focus of this report continues to remain upon conventional moving grate EfWs and Advanced Conversion Technology ("ACT") facilities in the UK generating energy from the combustion of Residual Waste. In 2020, in addition to the use of Residual Waste in the form of Solid Recovered Fuel at cement kilns, increased (but still very modest) tonnages of Residual Waste were co-incinerated at biomass facilities including Slough Fibrepower, Boston (Biomass No 3 Limited) and RWE Markinch. This data has once again been excluded but will be reviewed each year.

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.

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

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Front Cover Image: Javelin Park Energy Recovery Facility, fully operational in 2020 Courtesy: Urbaser Environmental Ltd

1. SUMMARY OBSERVATIONS

Above all this year's report highlights the resilience of the UK EfW sector to the effects of COVID-19.

Residual Waste Processed	↑ 10.5%	Power Exported to Grid	↑ 15.8%	Average Availability	↓ 0.4%
Number of Heat Exporting EfWs	↑ 2	Total Heat Exported	↑ 19.3%	Net CO_2 Impact / Tonne Input	↑ 1.1%

Figure 1: Comparison of 2020 vs 2019

In 2020 a total of just under 14.0Mt of Residual Waste was processed in UK EfWs, up from 12.6Mt in 2019 and higher than projected in the 2019 report.

Improved turbine availability (after the challenges reported in previous years) and two new heat exporting EfWs means that energy generation in terms of heat and power exports increased significantly, both on a like-for-like and absolute basis.

During 2020 six EfWs, including three ACTs, reported that they had achieved takeover. Meanwhile, Tolvik reported five EfWs achieving "financial close" with commencement of main construction works – Newhurst, Drakelow ACT, Newport, Protos and Slough (where ground preparation had previously commenced). This may not be entirely a co-incidence, as in a sector requiring specialist skills and experience, as EfWs complete construction so essential construction managers and engineers become available.

A number of new investors also entered the sector during the year as 2020 was arguably the busiest year in terms of M&A activity. With this has come increased leveraged finance at both corporate and asset level.

Outlook

Following the influential Committee on Climate Change ("CCC") sixth Carbon Budget suggestion that Carbon Capture and Storage ("CCS") should be one of the many requirements of the UK Government's Net Zero strategy, debate as to the role of EfW in the UK's climate change, resources and waste management sectors has intensified in recent months.

At the time of writing the Government seems set to put many of the CCC's recommendations into law. But before any meaningful investment in CCS can be made there is a need for greater understanding of the technical and economic implications of the technology in the context of EfW, including the potential for negative emissions and the benefits (or otherwise) if an EfW is located in a carbon capture "cluster" or CO2 is transported from an EfW to such a cluster.

Understandably the focus on carbon emissions and the role of EfW means that, as when the UK faced the EU Landfill Directive targets, stakeholders (including Government) have a need to better understand the quantum, composition and available alternatives for the future treatment of Residual Waste. A range of recommendations are likely to result – some identifying ways in which the carbon performance of EfW can be improved and others suggesting novel technical options.

With significant investor appetite in the green economy, funds for the development of large scale Residual Waste treatment facilities based on novel solutions are more likely than ever to be potentially available. However, past experience suggests that such solutions can face operational challenges.

The UK continues to generate around 70,000 tonnes of Residual Waste a day, and exports and landfill options are in decline. The challenges of 2020 provided the EfW sector with the opportunity to demonstrate its operational resilience whilst highlighting that, in the understandable search for better carbon solutions for Residual Waste, stakeholders must be very careful not to lose sight of the critical need for operational reliability.

2. MARKET OVERVIEW

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

As at December 2020 there were 54 fully operational EfWs in the UK.

The Total Headline Capacity of those EfWs which were fully operational or in late stage commissioning was 16.36Mtpa with a further 3.84Mtpa of EfW capacity either in construction or about to commence construction.

Mtpa	Fully Operational	In Late Stage Commissioning	Total Headline Capacity	In Construction	Total
2016	10.48	1.28	11.76	4.16	15.92
2017	11.85	0.41	12.26	3.64	15.90
2018	12.42	1.07	13.50	3.37	16.87
2019	14.60	0.80	15.40	3.10	18.50
2020	**16.13**	**0.23**	**16.36**	**3.84**	**20.20**

Figure 2: Headline Capacity (as at December 2020) Source: Tolvik analysis

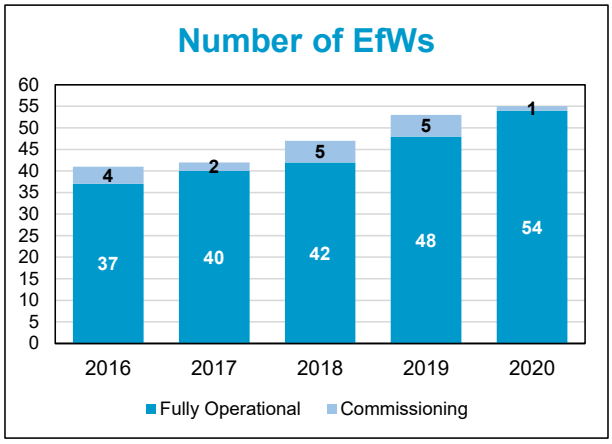


Figure 3: Number of EfW Facilities

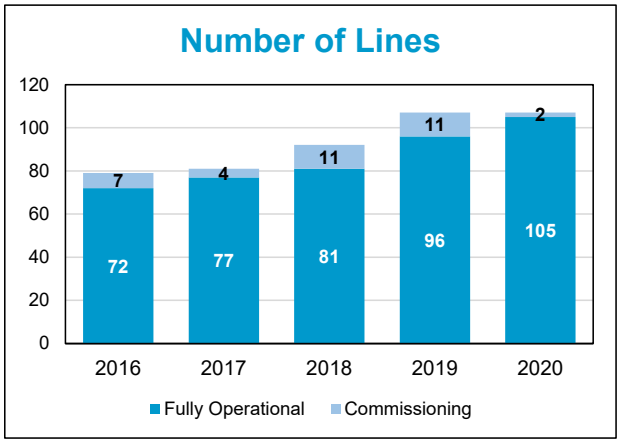


Figure 4: Number of Lines at EfW Facilities

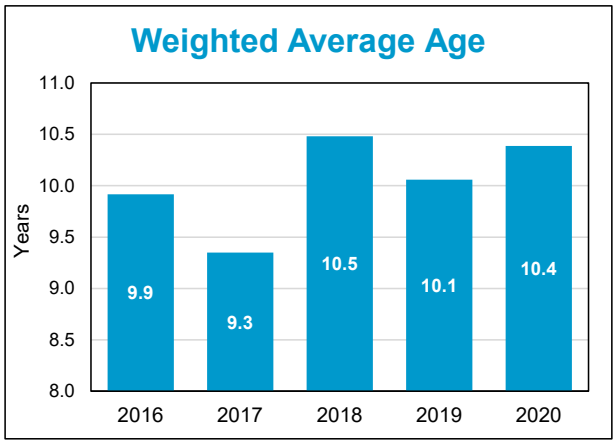


Figure 5: Weighted Average Age by Capacity (as at December 2020) Source: Tolvik analysis

Figure 5 shows the capacity-weighted average age of UK EfWs – as can be seen over the last 5 years the average age has been maintained at 9-11 years as new EfWs 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

In 2020 a total of 13.96Mt of Residual Waste was processed in UK EfWs, an increase of 10.5% on 2019.

Total inputs were the equivalent, for EfWs fully operational throughout the year, to 86.4% of the total Headline Capacity – a lower figure than previous years reflecting the performance of certain ACT facilities.

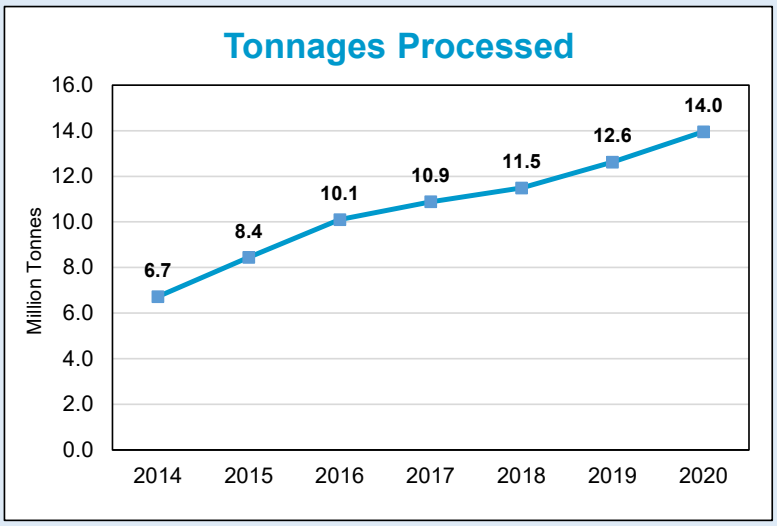


Figure 6: Total Tonnage of waste accepted at EfWs in 2014-2020 Source: APR

Mt	Input Tonnage	Inputs as % of Headline Capacity
2016	10.10	91.0%
2017	10.88	90.8%
2018	11.49	90.9%
2019	12.63	89.7%
2020	**13.96**	**86.4%**

Figure 7: Annual EfW Inputs
Source: APR

The Role of EfW in the UK Residual Waste Market

Whilst COVID-19 means that, until more data is available, there is greater uncertainty than usual with respect to Residual Waste tonnages in the UK, early data suggests that Residual Waste inputs to EfWs in the UK represented 52% *(2019: 46%)* of the overall UK Residual Waste market.

It is estimated that in 2020 RDF Exports from the UK declined by around 31% when compared with 2019.

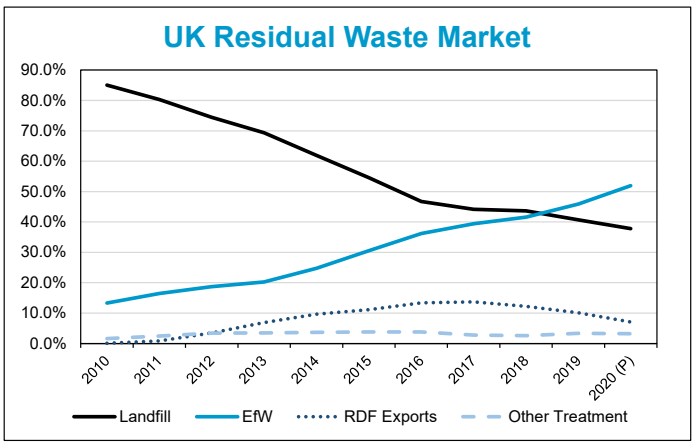


Figure 8: Development of the UK Residual Waste Treatment; 2020 Estimate
Source: Tolvik analysis

EfW Inputs by Waste Source and Code

Based on a detailed review of APRs for 2020 and Wastedataflow[1] for 2019/20 and other available data, it is estimated that in 2020 79.9% of all EfW inputs were derived from Residual Local Authority Collected Waste ("LACW") with the remainder being Commercial and Industrial ("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	**79.9%**	**20.1%**	**N/A**	**N/A**	**N/A**

Figure 9: Inputs by Waste Source Source: Wastedataflow, APR, Waste Data Interrogator[2]

According to available data, 63.4% of inputs to EfW in 2019 (the last year for which data was available) was unprocessed Municipal Waste with a further 34.4% of inputs being Residual Waste arising after prior treatment.

In 2020, 35kt (*2019: 17kt*) of Clinical Waste were reported by operators as being processed by EfWs – circa 9% of Clinical Waste generated in the UK in 2020.

Net Calorific Value of Residual Waste

A detailed analysis in 2017 by Tolvik of data relating to the Net Calorific Value ("NCV") 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 2020, 20 facilities provided NCV data within their APR. All the reporting facilities were permitted to accept waste under 20 03 xx codes – i.e. untreated wastes. The weighted average NCV for all inputs was **9.11MJ/kg** with the facilities in total accepting 88.2% LACW and 11.8% C&I Waste.

This data is entirely consistent with the 2017 analysis – which if applied to the proportion of wastes by source would result in an estimated weighted average NCV of 9.12MJ/kg.

However, as previously reported, there is a very wide range of results from facility to facility and so these averages need to be treated with caution.

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 <3%.

Operator	2020 Input (kt)	Share
Viridor	3,036	21.8%
Veolia	2,328	16.7%
Suez	2,168	15.5%
WTI	1,821	13.0%
FCC	1,468	10.5%
Council	878	6.3%
Cory	731	5.2%
Other	1,527	10.9%
Total	**13,957**	**100.0%**

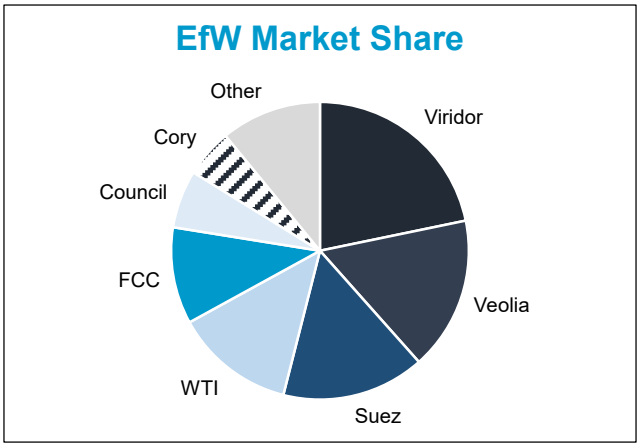


Figure 10: 2020 Share of Input Tonnage (includes Joint Ventures) Source: Tolvik analysis

4. ENERGY

It is estimated that the total power exported by EfWs in the UK in 2020 was 7,762GWh – approximately 2.5% of total net UK generation of 307,556 GWh[3].

	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}
2016	6,210	5,291	14.8%	15.3%	524	730
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	**8,994**	**7,762**	**13.7%**	**15.5%**	**557**	**1,651**

Figure 11: 2020 Power Generation Source: Tolvik analysis

2020 saw a modest improvement in power export per tonne of waste inputs following two years in which a number of EfWs suffered from significant turbine issues.

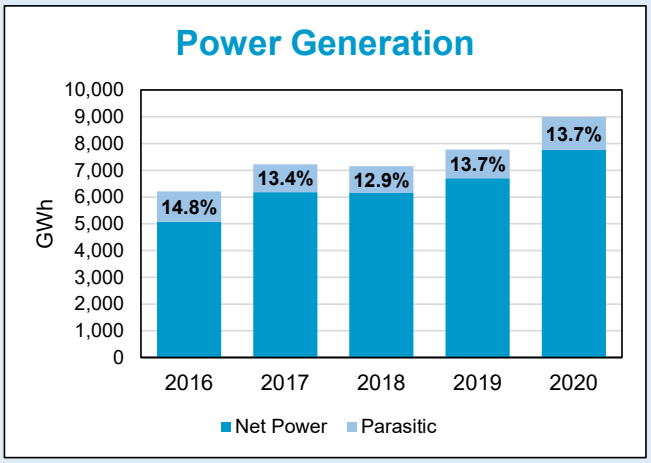


Figure 12: Power Generation from EfW

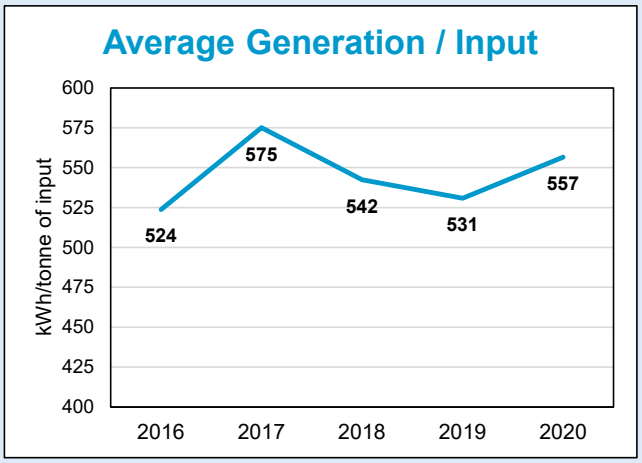


Figure 13: Average Power Generation per tonne of input

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 557kWh/t generated per tonne of waste input in 2020 *(2019: 531kWh/t),* across all EfWs the output ranged from Bolton with no power exported during the year (due to a fire in 2018) and Kirklees (with turbine availability of just 18%) to 882kWh/t at Ferrybridge FM2. The figure for Ferrybridge FM2 in part reflects its feedstock (solely RDF with a higher NCV), optimised design and the fact that it does not export heat.

The average parasitic load in 2020 was in part distorted by the figure for Kirklees (see above) but in total seven EfWs reported a parasitic load greater than 20%. Battlefield had the lowest reported parasitic load at 6.7%.

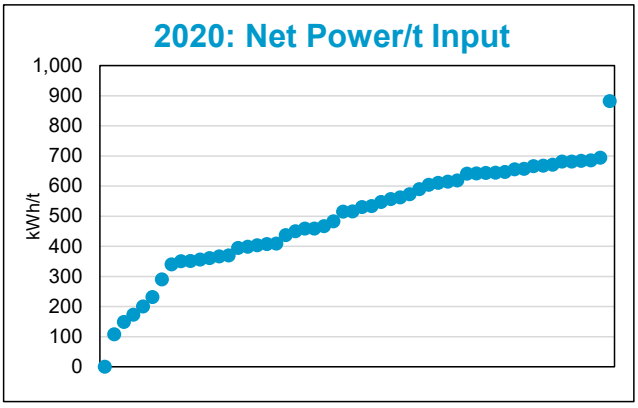


Figure 14: 2020 Net Power Exported per tonne of Input
Source: Tolvik analysis, 54 records

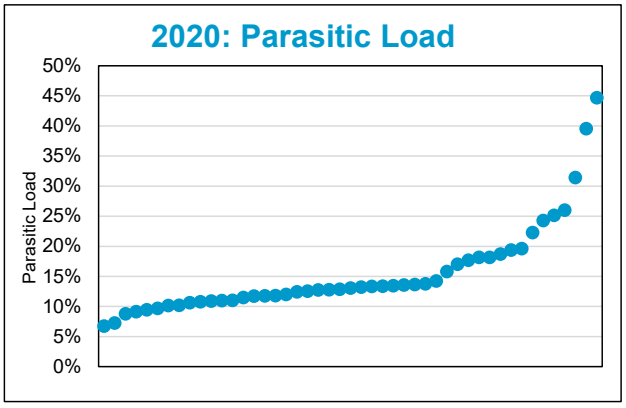


Figure 15: 2020 Parasitic Load Distribution
Source: Tolvik analysis, 47 records

Beneficial Heat Use

In 2020, 12 EfWs in the UK exported heat for beneficial use alongside power with an estimated total export of 1,651GWh$_{th.}$ *(2019: 1,384GWh$_{th}$)*. Across all EfWs this was the equivalent of 118kWh$_{th}$/tonne of inputs *(2019: 110kWh$_{th}$/tonne)*.

EfW	Est. Export GWh$_{th}$				Heat/Steam Offtake
	2017	2018	2019	2020	
Runcorn	405	408	405	**480**	Steam supply to Ineos
Eastcroft	224	332	420	**405**	Enviroenergy for electricity generation and hot water
Wilton 11	-	100	303	**373**	Adjacent Wilton International site
Kemsley	-	-	-	**123**	DS Smith papermill
Sheffield	96	112	111	**95**	District heating operated by Veolia
Devonport	54	59	48	**54**	Adjacent naval dock yard
Gremista	40	40	40	**50**	District heating on the Shetland Islands *(estimated)*
SELCHP	37	38	39	**40**	District heating operated by Veolia
Leeds	-	8	2	**14**	District heating operated by Vital Energi
Coventry	5	11	13	**8**	District heating operated by Engie
NewLincs	3	3	3	**7**	To local industry
Edmonton	-	-	-	**2**	Very modest export reported
Total	**865**	**1,112**	**1,384**	**1,651**	

Figure 16: Reported Heat Exports from EfWs Source: APR

5. OPERATIONS

Across those EfWs which were operational for the whole of 2020, the average availability based on waste combustion was 89.2% (2019: 89.5%). The availability based on turbine operations was lower at 85.9% but this was a material improvement on the 2019 figure of 81.9%.

Figure 17 also shows that the average APCr produced per tonne of input waste has fallen modestly in recent years.

	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)
2016	90.2%	90.3%	N/A	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%
2019	89.5%	90.0%	81.9%	19.4%	3.3%	1.9%
2020	**89.2%**	**89.6%**	**85.9%**	**19.9%**	**3.2%**	**1.9%**

Figure 17: Operational Data Source: APR

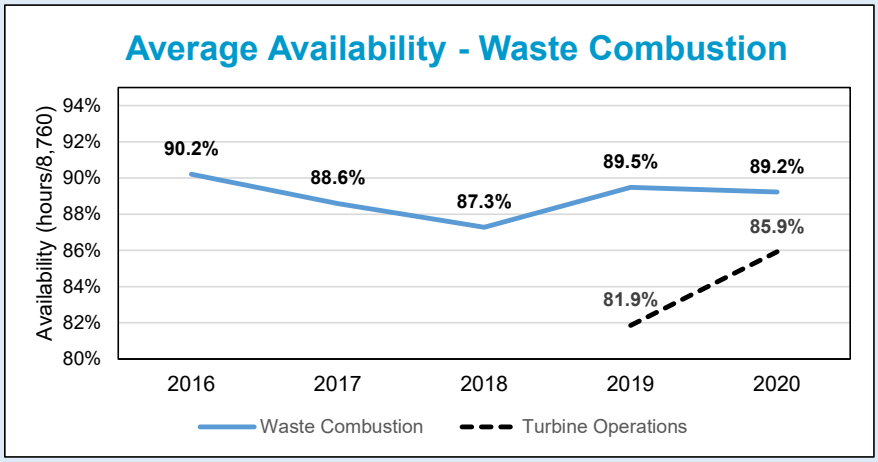


Figure 18: Average EfW Availability – Hours Source: Tolvik analysis

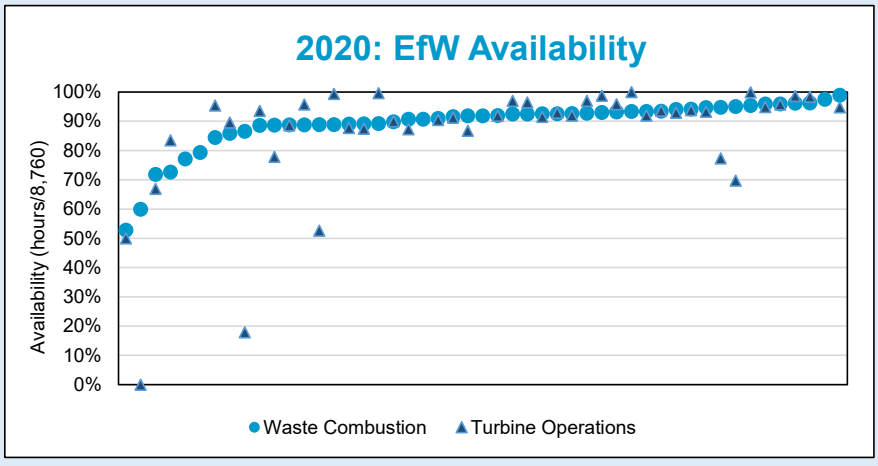


Figure 19: 2020 EfW Availability – Hours Source: Tolvik analysis, 49 records

Operator	Number of EfWs reporting	Simple Average Availability	Capacity Weighted Average
WTI	3	93.9%	94.1%
Veolia	10	94.4%	93.7%
Public Sector	3	91.9%	92.5%
MESE	3	91.7%	91.0%
Viridor	8	91.2%	90.8%
Suez	7	85.4%	88.9%
MVV	2	85.5%	88.4%
Other	4	83.3%	87.3%
FCC	6	88.5%	86.0%
Cory	1	84.5%	84.5%
Amey	2	74.5%	75.9%
Average		**89.2%**	**89.6%**

Figure 20: 2020 Average Availability (Waste Combustion) by Operator – EfWs operational for the full year

During 2020, eight EfWs reported an average Waste Combustion availability of greater than 95%. These ranged in scale from WTI's Ferrybridge FM1 down to Lancing together with five Veolia facilities and Viridor's Beddington Lane.

Of those reporting four EfWs had an availability below 75% - Bolton, Allington and two ACTs – Milton Keynes and Hoddesdon.

There was a significant increase in the number of facilities reporting average Turbine Operations availability in excess of 95% during 2020 – up from seven in 2019 to 14. However six EfWs reported a figure below 75% including Bolton and Kirklees (see previous section), two ACTs (as above) plus Hanford and Ferrybridge FM1.

Outputs

Incinerator Bottom Ash

In 2020 IBA accounted on average for 19.9% *(2019: 19.4%)* of all waste inputs with the average percentage generated falling steadily over time. In total, the tonnage of IBA generated in 2020 was just under 2.7Mt.

IBA outputs expressed as a percentage of waste inputs fell within the 11% - 30% range, with Allington, as a fluidised bed facility, once again reporting the lowest percentage.

Air Pollution Control Residues

In 2020 APCr generation was 3.2% of waste inputs *(2019: 3.3%)*. The total generation of APCr in 2020 is estimated to have been circa 450kt with 33.7% recycled.

Five facilities generated more than 5% of APCr as a percentage of inputs – the fluidised bed facilities Allington, Baldovie together with Milton Keynes ACT, Hoddesdon ACT and Lancing.

Two Viridor facilities, Trident Park and Beddington Lane, generated less than 2% of APCr.

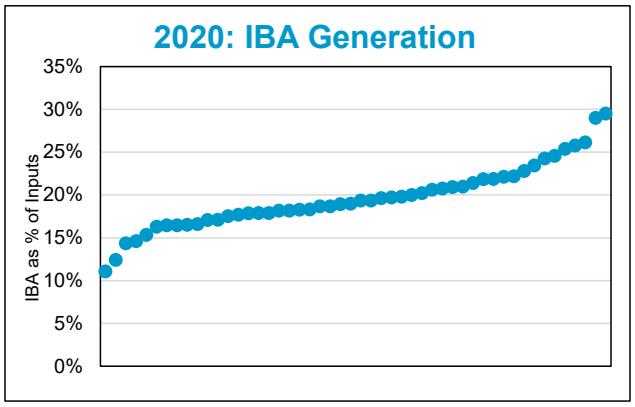


Figure 21: 2020 Distribution of IBA Generation (as % of inputs)
Source: Tolvik analysis, 50 records

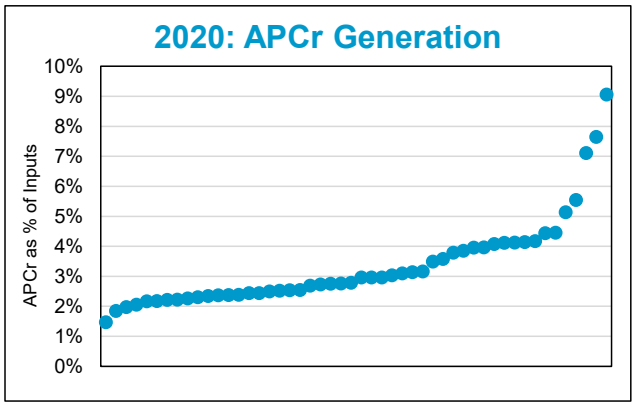


Figure 22: 2020 Distribution of APCr Generation (as % of inputs)
Source: Tolvik analysis, 50 records

Consumable Use

The analysis in this section is calibrated to “Specific Usage” i.e. usage per tonne of waste input. The change in technology mix etc means that there are no discernible trends with respect to any of the consumables.

Consumable	Per tonne input	Low	Median	High
Total Water Usage	m^3	0.02	0.23	4.43
Activated carbon or coke	kgs	0.02	0.27	0.78
(Hydrated) lime or sodium bicarb	kgs	2.40	10.50	26.80
Urea	kgs	0.12	1.29	5.60
Ammonia	kgs	0.03	1.51	3.52
Fuel Oil	ltrs	0.01	1.43	47.32

Figure 23: 2020 Specific Consumable Usage (where reported) Source: APR

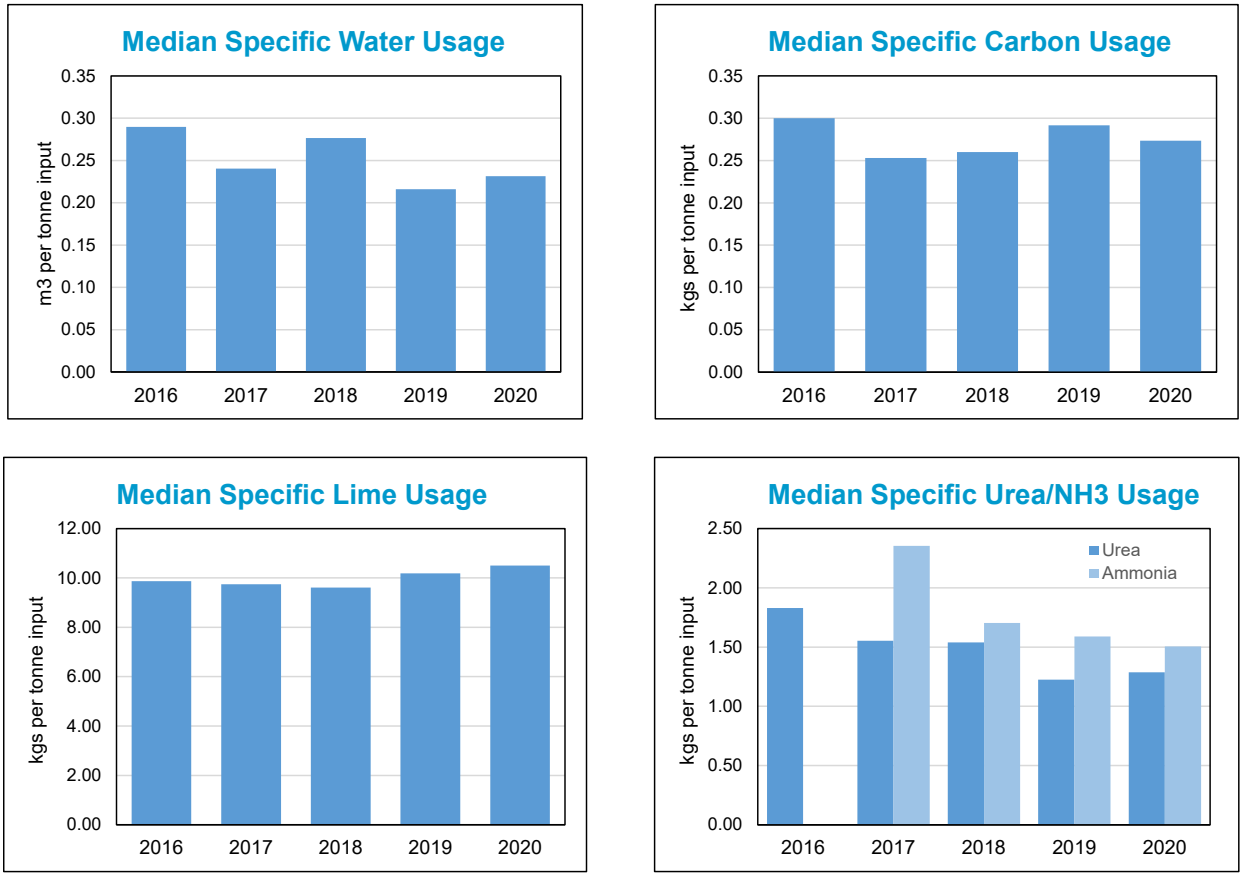


Figure 24: Trends in Specific Consumable Usage (where reported) Source: APR

Efficiency and R1

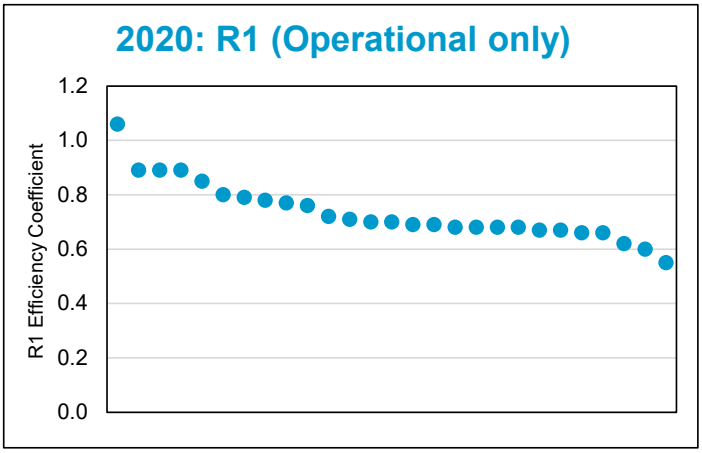


Figure 25: R1 (Operational Status only) in England Source: EA

As at April 2021, based on EA data and information in the APR, 35 EfWs with a total headline capacity of 12.1Mt were accredited as R1 ("Recovery") operations with 27 of the R1 calculations based on operational data and eight on design data. To achieve R1 requires an efficiency coefficient of at least 0.60 (for existing EfWs) and 0.65 (for newbuilds).

One EfW reported an efficiency coefficient of 0.55 for the year – below the R1 criteria.

Carbon Intensity of EfW (per tonne)

Following last year's report, this section once again considers the "carbon intensity" per tonne of Residual Waste processed across the UK EfW fleet.

From various discussions, it is clear that, in the absence of a standard methodology, there is a significant element of subjectivity in estimating carbon intensity of EfW. This is further exacerbated by the wide variation in operational performance of individual EfWs and given that EfWs accept a range of wastes.

There is a general consensus that, as EfWs are not simply power stations it is incorrect to benchmark them solely against other sources of power generation and any estimate of carbon intensity needs to recognise their role in diverting Residual Waste from landfill and, depending on their operational configuration, generating heat 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 in last year's report, we have based our data on Pollution Inventory returns. It is clear that, in the light of increased interest, operators are starting to give greater attention to their submissions - which means that some caution is therefore needed in comparing year on year trends.

Last year's report estimated the percentage of fossil CO_2 emitted by reference to 2017 composition data prepared by WRAP. The same approach has been taken this year but, in the light of feedback, percentages have been calculated, consistent with Ofgem methodology, on Gross Calorific Values rather than Net Calorific Values. This leads to a modest reduction in the fossil composition of both Household and C&I Waste but brings the analysis into line with most other similar assessments.

Excluding any benefits from avoiding landfill, it is estimated that in 2020, on average across the UK fleet, net carbon emissions were 0.270 tCO_2e per tonne of waste, slightly up on the recalculated 0.267 tCO_2e per tonne of waste seen in 2019. This increase reflects the ongoing decarbonisation of the grid, so reducing the benefits of power and heat exports from EfW.

These compare with an estimate in a recent report that the net impact of landfilling Residual Waste is 0.320 tCO_2e per tonne – suggesting an average carbon benefit of EfW when compared with landfill of around 0.050 tCO_2e per tonne of Residual Waste. Clearly the range in performance of individual EfWs means that some EfWs will generate a bigger carbon benefit than average and the least efficient will show no benefit at all.

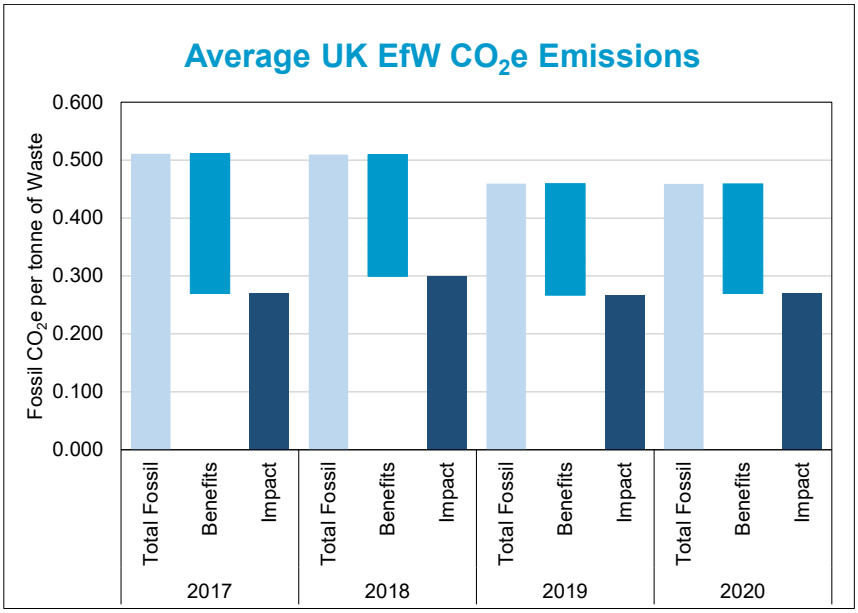


Figure 26: Average Net CO_2e Emissions from UK EfWs Sources: See Figure 27

	Per tonne of Input Waste	Unit	Data Source	2017	2018	2019	2020
	Average CO_2 emitted	*tCO_2*	*Pollution Inventory[4]*	*1.040*	*1.037*	*0.934*	*0.934*
	% Fossil		*WRAP Composition – 2017[5]*	*47.9%*	*47.9%*	*47.9%*	*47.9%*
Emissions	Fossil CO_2 emitted	tCO_2		0.498	0.497	0.448	0.448
	Other GHG emitted	tCO_2e	*Pollution Inventory[4]*	0.009	0.009	0.008	0.008
	Fuel/Imported Power	tCO_2e	*APR and UK GHG Conversion Factor*	0.005	0.004	0.004	0.004
	Total Fossil Emissions	**tCO_2e**		**0.511**	**0.510**	**0.459**	**0.459**
EfW Output	*Power Export*	*MWh*	*Figures 11 and 17*	*0.575*	*0.542*	*0.531*	*0.557*
	Heat Export	*MWh*		*0.080*	*0.097*	*0.110*	*0.118*
	Recycling Benefit	*t*		*0.019*	*0.019*	*0.019*	*0.019*
Substitution Benefits	Power Export	tCO_2e	*Converted using UK Government GHG Conversion Factors for company reporting for the applicable year[6]*	(0.202)	(0.154)	(0.136)	(0.130)
	Heat Export	tCO_2e		(0.016)	(0.018)	(0.019)	(0.020)
	Recycling Benefit	tCO_2e		(0.023)	(0.039)	(0.038)	(0.039)
	Total Benefits	**tCO_2e**		**(0.241)**	**(0.210)**	**(0.193)**	**(0.189)**
	Impact	**tCO_2e**		**0.270**	**0.299**	**0.267**	**0.270**
	Avoided Landfill	*tCO_2e*	*Eunomia Greenhouse Gas and Air Quality Impacts of Incineration and Landfill[7]*	*(0.320)*			
	Net Impact	***tCO_2e***		***(0.050)***	***(0.021)***	***(0.053)***	***(0.050)***

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 that 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 2020 emissions were 29.1% of the Emissions Limit Value ("ELV") *(2019: 28.8%).* Meanwhile, for periodically monitored emissions, on average emissions were 8.1% of ELV *(2019: 8.5%).*

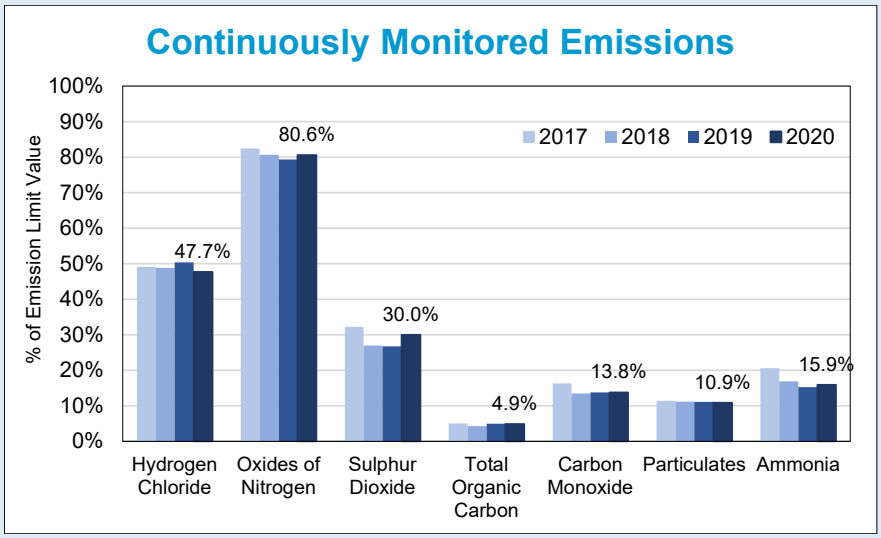


Figure 28: Continuously Monitored Emissions to Air Source: APR

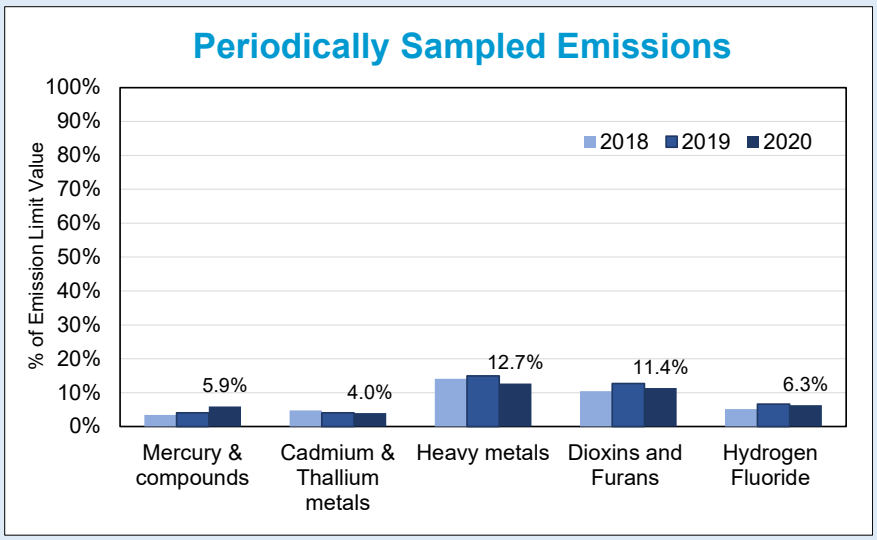


Figure 29: Periodically Monitored Emissions to Air Source: APR

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.

% of Emissions Limit Value	2017	2018	2019	2020
Oxides of Nitrogen	82.5%	80.7%	79.4%	**80.6%**
Hydrogen Chloride	49.1%	48.8%	50.4%	**47.7%**
Sulphur Dioxide	32.3%	27.0%	26.7%	**30.0%**
Ammonia	20.6%	16.9%	15.2%	**15.9%**
Carbon Monoxide	16.3%	13.5%	13.7%	**13.8%**
Particulates	11.4%	11.2%	11.1%	**10.9%**
Total Organic Carbon	5.0%	4.3%	4.9%	**4.9%**
Simple Average	**31.0%**	**28.9%**	**28.8%**	**29.1%**

Figure 30: Continuously Monitored Emissions to Air 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**
Abnormal Events	Instances	2019	87	44	2.0
		2020	**72**	**48**	**1.5**
Permit Breaches	Instances	2019	127	39	3.3
		2020	**148**	**47**	**3.1**

Figure 31: Abnormal Operations Source: APR

In 2020 one facility, not previously operational accounted for 76 hours of abnormal operations and this was solely the cause of the increase in abnormal hours between 2019 and 2020.

As in 2019, in 2020 five different EfWs reported more than 10 permit breaches and together accounted for 57% of all breaches.

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 2020/21, the performance of the sector as measured by OPRA scores appears to have improved modestly over the last 3 years.

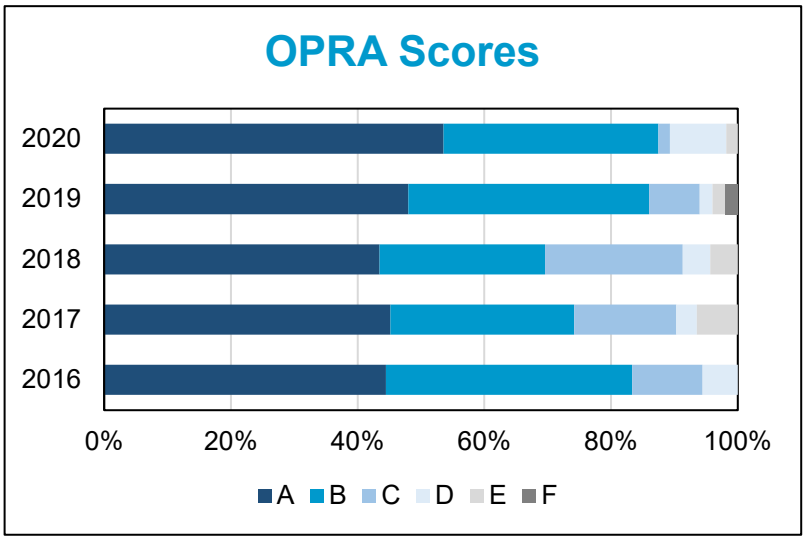


Figure 32: OPRA Scores by Facility Source: EA, APR, SEPA

7. CAPACITY DEVELOPMENT

Based on EfWs which were operational or in construction as at December 2020, Section 2 identifies a Headline Capacity of 20.20Mt.

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 36 to 38 in Appendix 1) that by 2025 the UK Operational Capacity will be **18.2Mt.**

For reference, for the first time, Figure 33 also shows historic Residual Waste tonnages in the UK – including a preliminary estimate for 2020. 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.

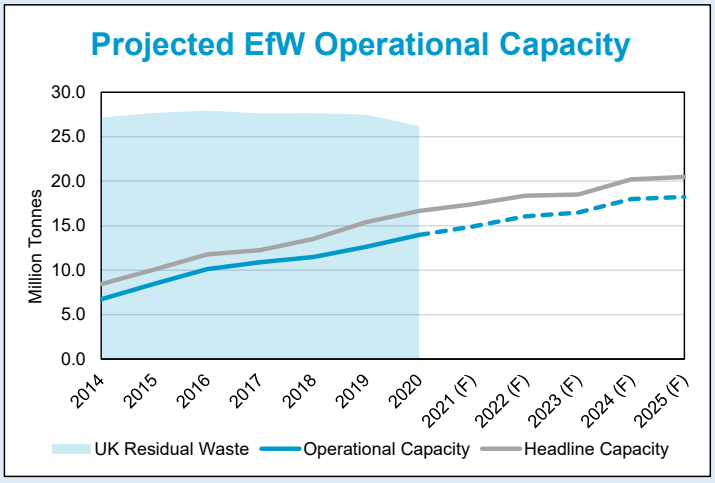


Figure 33: Projected UK EfW Operational Capacity Source: Tolvik analysis

EfW in Development – Additional Capacity

The Headline and Operational capacity beyond 2025 will be dependent on the development of additional EfWs. Tolvik's database of active projects continued an upward trajectory and totalled 22.3Mt of Headline Capacity as at December 2020 *(2019: 21.0Mtpa).* It included EfW projects seeking planning consent, have planning consent or for which planning consent has been refused but some form of appeal/new submission is expected.

Of this potential additional EfW capacity, 60% has planning consent – up from 50% in 2019 – suggesting that fewer new projects are now being brought forward and that those applications already in the system are slowly working their way through to planning decisions.

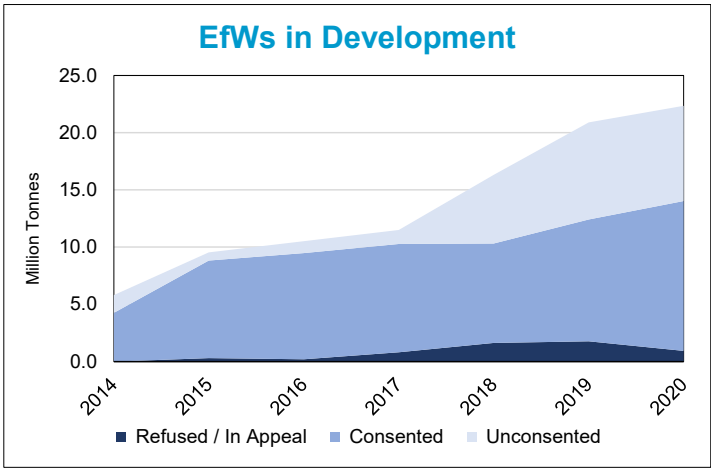


Figure 34: Historic EfW Capacity in Development

APPENDIX 1: ENERGY FROM WASTE FACILITIES INCLUDED IN THE REPORT

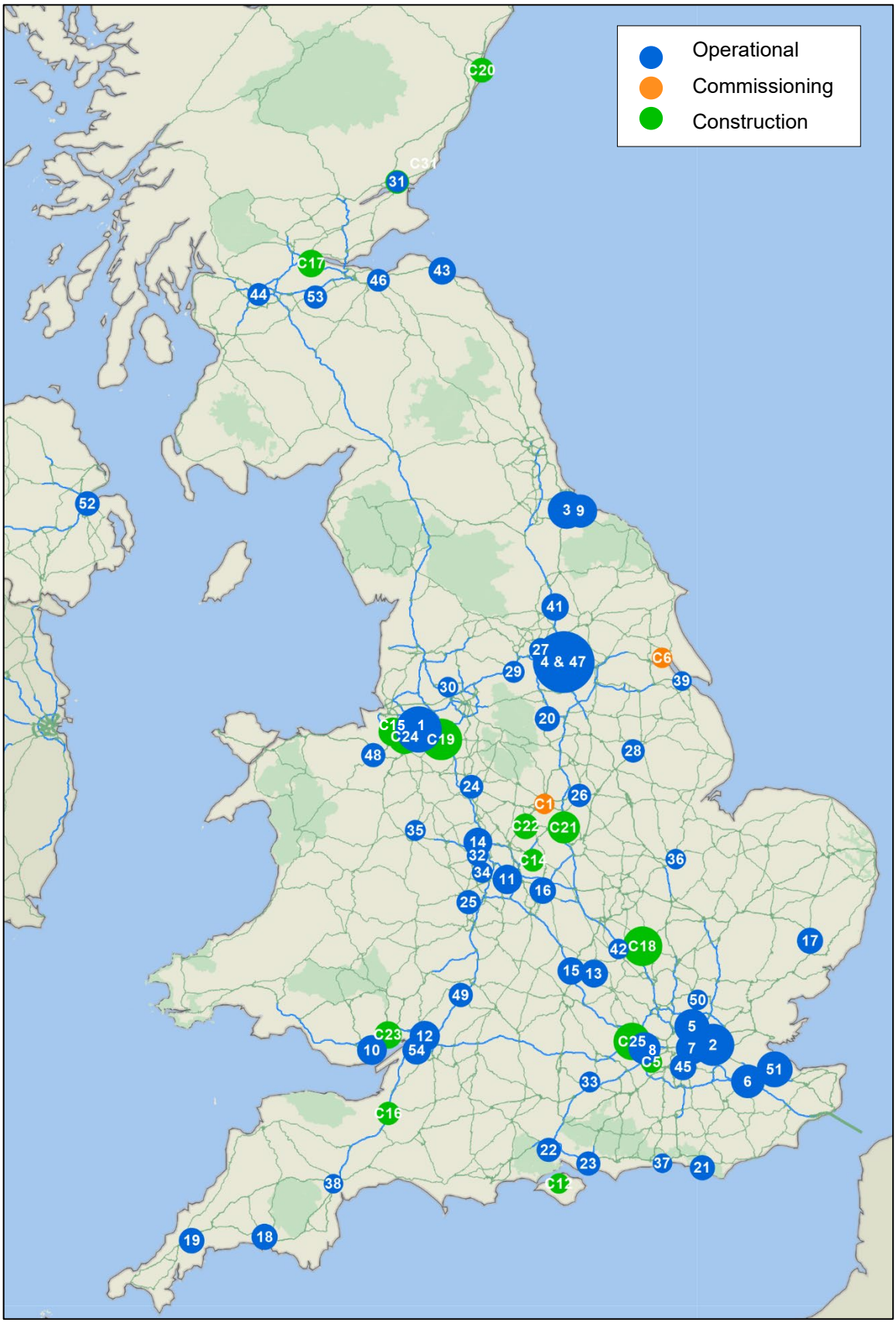


Figure 35: Location of EfW facilities (for further details on the EfWs shown see Figures 36-38)

Operational EfWs

	Permitted Name	Known As	Location	Operator	Capacity (ktpa)	Processed (ktpa) 2018	2019	2020
1	Runcorn EfW Facility	Runcorn	Halton	Viridor	1,100	884	962	943
2	Riverside Resource Recovery Facility	Riverside	Bexley	Cory	785	740	743	731
3	Tees Valley - EfW Facility	Tees Valley	Stockton-on-Tees	Suez	756	637	651	582
4	Ferrybridge Multifuel 1	Ferrybridge FM1	Wakefield	WTI	675	647	667	599
47	Ferrybridge Multifuel 2	Ferrybridge FM2	Wakefield	WTI	675	0	129	615
5	EcoPark Energy Centre	Edmonton	Enfield	Council	620	518	498	542
6	Allington Waste Management Facility	Allington	Kent	FCC	560	492	488	423
51	Kemsley Park EfW	Kemsley	Kent	WTI	550			410
9	Wilton 11 EfW	Wilton 11	Middlesborough	Suez	500	467	448	470
7	SELCHP ERF	SELCHP	Lewisham	Veolia	464	441	439	369
8	Lakeside EfW	Lakeside	Slough	Lakeside	450	431	427	420
10	Cardiff Energy Recovery Facility	Trident Park	Cardiff	Viridor	425	376	366	379
11	Tyseley ERF	Tyseley	Birmingham	Veolia	400	343	343	363
12	Severnside Energy Recovery Centre	Severnside	S.Gloucestershire	Suez	425	377	397	411
13	Greatmoor EfW	Greatmoor	Buckinghamshire	FCC	345	308	295	300
14	Staffordshire ERF	Four Ashes	Staffordshire	Veolia	340	336	337	340
15	Ardley EfW Facility	Ardley	Oxfordshire	Viridor	326	290	280	290
41	Allerton Waste Recovery Park	Allerton Park	North Yorkshire	Amey	320	244	255	227
16	CSWDC Waste to Energy Plant	Coventry	Coventry	Council	315	289	299	313
45	Beddington Energy Recovery Facility	Beddington Lane	Croydon	Viridor	347	80	279	322
54	Severn Road RRC	Avonmouth	Bristol	Viridor	350			68
43	Dunbar Energy Recovery Facility	Dunbar	East Lothian	Viridor	325	40	251	325
17	SUEZ Suffolk - EfW Facility	Great Blakenham	Suffolk	Suez	295	264	267	291
18	Devonport EfW CHP Facility	Devonport	Plymouth	MVV	265	255	265	261
20	Sheffield ERF	Sheffield	Sheffield	Veolia	245	234	230	240
21	Newhaven ERF	Newhaven	East Sussex	Veolia	242	224	223	229
19	Cornwall Energy Recovery Centre	Cornwall	Cornwall	Suez	240	221	243	237
25	EnviRecover EfW Facility	Hartlebury	Worcestershire	Severn	230	200	201	213
22	Integra South West ERF	Marchwood	Southampton	Veolia	220	199	211	204
23	Integra South East ERF	Portsmouth	Portsmouth	Veolia	210	207	195	205
24	Stoke EfW Facility	Hanford	Stoke-on-Trent	MESE	210	186	179	189
26	Eastcroft EfW Facility	Eastcroft	Nottingham	FCC	200	177	188	191
48	Parc Adfer ERF	Parc Adfer	Deeside	WTI	200	0	58	197
28	Lincolnshire EfW Facility	North Hykeham	Lincolnshire	FCC	190	171	175	185
46	Millerhill Recycling and ERC	Millerhill	Edinburgh	FCC	190	16	142	157
49	Javelin Park ERF	Javelin Park	Gloucestershire	UBB	190		68	183
27	Leeds Recycling and ERF	Leeds	Leeds	Veolia	190	187	174	182
53	Levenseat Renewable Energy	Levenseat ACT	West Lothian	Outotec	180		20	50 (est)
44	Glasgow RREC	Polmadie ACT	Glasgow	Viridor	150	7	83	149 (est)
29	Kirklees EfW Facility	Kirklees	Huddersfield	Suez	150	124	134	124
30	Bolton ERF	Bolton	Gtr Manchester	Suez	120	29	76	53
31	Baldovie Waste To Energy Plant	Baldovie	Dundee	MVV	120	93	96	92
52	Full Circle Generation EfW	Belfast ACT	Belfast	Bouygues	120		34	76
32	Wolverhampton EfW Facility	Wolverhampton	Wolverhampton	MESE	118	110	114	114
33	Integra North ERF	Chineham	Hampshire	Veolia	110	93	94	98
34	Dudley EfW Facility	Dudley	Dudley	MESE	105	94	96	98
35	Battlefield EfW Facility	Battlefield	Shropshire	Veolia	102	96	99	97
42	Milton Keynes Waste Recovery Park	Milton Keynes ACT	Milton Keynes	Amey	94	27	58	66
50	Hoddesdon EfW Plant	Hoddesdon ACT	Hertfordshire	Bouygues	90		13	39
36	Peterborough EfW Facility	Peterborough	Peterborough	Viridor	85	81	80	80
37	Enviropower Ltd, Lancing	Lancing	West Sussex	Enviropower	75	60	55	64
38	Exeter ERF	Exeter	Devon	Viridor	60	58	58	60
39	Integrated Waste Management Facility	NewLincs	NE Lincolnshire	Tiru	56	51	51	54
40	Energy Recovery Plant	Gremista	Shetland Islands	Council	26	23	21	23
	Other EfWs in Commissioning but not achieved Takeover in 2020					57	70	13
			Totals		**16,131**	**11,488**	**12,626**	**13,957**

Figure 36: Operational EfWs in 2020 Source: APR

Please note, those highlighted blue were fully operational for part of the year only

EfWs In Commissioning

	Permitted Name	Known As	Location	Operator	Start Date	Headline Capacity (ktpa)	Net Input 2019 (ktpa)	Net Input 2020 (ktpa)
C1	Sinfin IWTC	Sinfin Road ACT	Derby	Mothballed	Q3 2014	0	49	0
C6	Hull Energy Works	Energy Works ACT	Hull	Engie	Q1 2016	227	21	13
				Total		**227**	**70**	**13**

Figure 37: EfWs In Commissioning as at December 2020 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
C14	Baddersley EfW	Baddersley	Warwickshire	Equitix	Q1 2018	100
C31	Baldovie Waste To Energy Plant (New)	Baldovie	Dundee	MVV	Q1 2018	110
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	Q4 2018	237
C18	Rookery South ERF	Rookery South	C Bedfordshire	Covanta/GIG	Q1 2019	545
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	180
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
				Total		**3,838**

Figure 38: EfWs In Construction in 2020 Source: Tolvik analysis

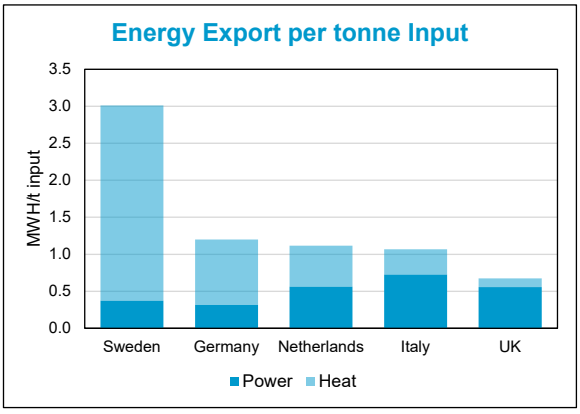
Developments January 2021 – April 2021

No additional EfW capacity reached financial close in Q1 2021.

APPENDIX 2: INTERNATIONAL BENCHMARKS

Heat and Power Generation

As Figure 39 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 (2019)[8]	0.37	2.64	3.01
Germany (2019)[9]	0.31	0.88	1.20
Netherlands (2018)[10]	0.56	0.55	1.12
Italy (2019)[11]	0.73	0.34	1.07
UK (2020)	**0.56**	**0.12**	**0.68**

Figure 39: Latest European Benchmarks – Energy Export

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.

SEPA: Contains SEPA data © Scottish Environmental Protection Agency and database right 2020.

(1) http://www.wastedataflow.org/ Q100 for four quarters Apr 2019 – Mar 2020

(2) Environment Agency: 2019 Waste Data Interrogator – Incinerator Waste Returns https://data.gov.uk/dataset/d409b2ba-796c-4436-82c7-eb1831a9ef25/2019-waste-data-interrogator

(3) 2020 Digest of UK Energy Statistics ("DUKES") Table 5.5 https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2020

(4) 2019 Pollution Inventory Dataset – Version 1 https://data.gov.uk/dataset/cfd94301-a2f2-48a2-9915-e477ca6d8b7e/pollution-inventory

(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

(7) https://www.eunomia.co.uk/reports-tools/greenhouse-gas-and-air-quality-impacts-of-incineration-and-landfill/

(8) Sweden - Avfall Sverige: Svensk Avfallshantering 2019

(9) Germany - ITAD: Jahresbericht 2019

(10) Netherlands - Afvalverwerking in Nederlands, gegevens 2018

(11) Italy - ISPRA: Rapporto Rifiuti Urbani Edizione 2019

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)
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 a RDF or SRF) or untreated (as "black bag" waste).
SEPA	Scottish Environmental Protection Agency

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