Electrical Waste: Challenges & Opportunities 2023

Final report

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Anthesis

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MATERIAL FOCUS

Disclaimer

Electrical Waste: Challenges & Opportunities 2023

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About Anthesis

Anthesis is the Sustainability Activator.

We are the largest group of dedicated sustainability experts in the world: a team of 1000+ people, working across 21 countries, to serve more than 2,600 clients.

We exist to shape a more productive and resilient world by helping organisations transition to new models of sustainable performance.

Our team combines broad and deep sustainability expertise with the commercial and operational capabilities it takes to conceive and deliver real change.

Executive summary

Since the WEEE Regulations came into force, there has been a gap in the understanding between the weight of EEE sales and WEEE collection and treatment. Mapping of pathways of electricals has been carried out before but these have been higher level (e.g., Global e-waste monitor, or more targeted by product or geography (e.g., The Dutch WEEE Flows 2020).

Other previous studies into the unreported reuse, collection, storage, treatment and disposal of WEEE have been published however these vary in scope and representation of current trends and behaviours. Material Focus last commissioned a report, *Electrical Waste - Challenges and Opportunities* published in 2020[1], but since that time the economy, businesses and consumers have experienced great change. Material Focus have recommissioned Anthesis to update the research in 2023 and this new study aims to assess where we are now.

The research uses a mixture of new and updated data sources to measure types and weights of electricals as of 2021[2]. There are 8 priority EEE/WEEE flow pathways that have been refreshed as part of this work.

When considering all the types of consumer and business electricals it is important to note that there is no direct correlation between what is being sold and what is being discarded. Not all new purchases are directly replacing old and broken products. For example, when consumers buy their very first mobile phones or laptops, or new appliances for brand new homes and new technologies such as air-fryers. And when considering the weight of products being sold and recycled, not all new purchases of replacement products match the product that is being replaced. For example, a standard fridge freezer being replaced by an American style one, or a cathode ray tube TV being replaced by an LED flat panel, so there can be significant variables in product weights. That said, the relationship between EEE being sold (put on the market) and being discarded in the WEEE regulated system is still interesting to consider.

This research (Table 1) shows that there looks to be a growing gap between EEE sold and WEEE collected for reuse and recycling in the same period. The research looks to quantify some of the major pathways where these electricals might be in the EEE and WEEE system.

[1] https://www.materialfocus.org.uk/report-and-research/electrical-waste-challenges-opportunities-2/

[2] Study uses latest published records from which 2021 is the most recent data available,

Table 1 Summary of W/EEE Flows research updates

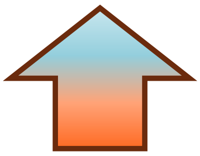
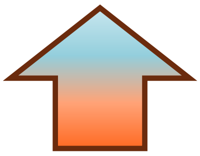
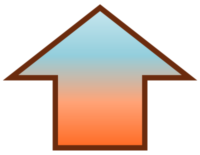
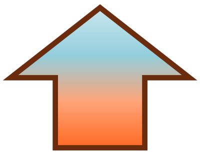
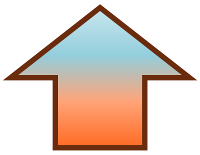
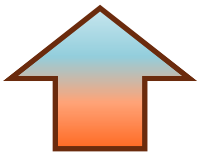
Comparing data W/EEE: 2017 / 2021

In use retention hoarding flow; EEE type covered	Weight (kt) 2017	Weight (kt) 2021
Use, Hoarding, retention	1,500	2,195
Reporting variances flow; EEE type covered	**Weight (kt)**	
Freeriders – not in UK POM	46	61
Recycled destroyed and exported flows; EEE type covered	**Weight (kt)**	
AATFs	653	498
Light iron	215	349
Residual	155	103
Theft	114	156
ITADs	90	98
Illegal export	32	187

Index of icons for WEE categories predominantly appearing in each recognised flow:

- Large household appliances
- Small household appliances
- IT & Telecoms
- Consumer equipment
- Lighting equipment
- Electrical & tools
- Toys leisure & sport
- Medical devices
- Monitoring & control instruments
- Automatic dispensers
- Display equipment
- Cooling appliances
- Gas discharge lamps & LED

The refreshed calculations indicate there have been important changes:-

	**Use, retention, held unused** – there is a much higher baseline calculation of the number of electricals placed on the market. This higher input causes a knock-on effect to the calculation of electricals counted in the home. This results in a considerably higher estimate of electricals being added to, and already in, homes and businesses in; use, retention (not often used) or hoarded (held but no longer used).
	**Free-riders** – businesses selling electricals, but not fulfilling their producer responsibility obligations, have increased. More devices are entering the UK that are not contributing financially to end of life disposal costs through the official EEE system.
	**AATF** – recycling recorded through the official WEEE compliance and treatment routes has reduced; less WEEE by weight was being treated in 2021 by approved recyclers and financed by producers than in 2017.
	**Light Iron** – more electricals are being mixed with other scrap metal recycling activities, meaning less WEEE is being recycled by approved recyclers and properly accounted for. This is likely resulting in loss and dilution of quality material outputs when WEEE is mixed with other materials.
	**Residual waste** – less electricals were found in household bins. The research found household bin samples contained fewer electricals as well as a reduction in the total weight of residual waste (all materials) overall. There are significant regional variances which could mean some samples are not very representative. Greater waste composition analysis across more Local Authorities would increase accuracy.
	**Theft** – electricals falling out of the official recorded systems has increased. From the modelling it is believed that it is most likely that these end up in; other recycling systems, (unofficial) reuse or export (likely illegal) destinations.
	**ITAD** – there is a greater number of electricals being refurbished, re-marketed and otherwise sent to be recycled to extract more value from devices, like IT and telecoms equipment by commercial enterprises who provide asset management services.
	**Illegal export** – there is a much higher estimate of the amount of (waste) electricals being exported from the UK. This is representative of the wider global problem with increasing disposal of waste through often illegal activities and misclassification of product/waste shipments allowing it to cross borders unnoticed.

The second part of this research was to better understand the regional differences in EEE and WEEE pathways across the UK, including used and waste electricals that have become held up in the system within 'use' and 'held unused' stages of their life cycle.

There are regional differences in the rates of WEEE recycling through local authority services across the UK

(Figure 1). This indicates the level of engagement and uptake of recycling is not uniform. Greater knowledge sharing and implementation of best practice to improve service availability, raising awareness of recycling options, and increasing consumer uptake could help to raise UK average recycling rates.

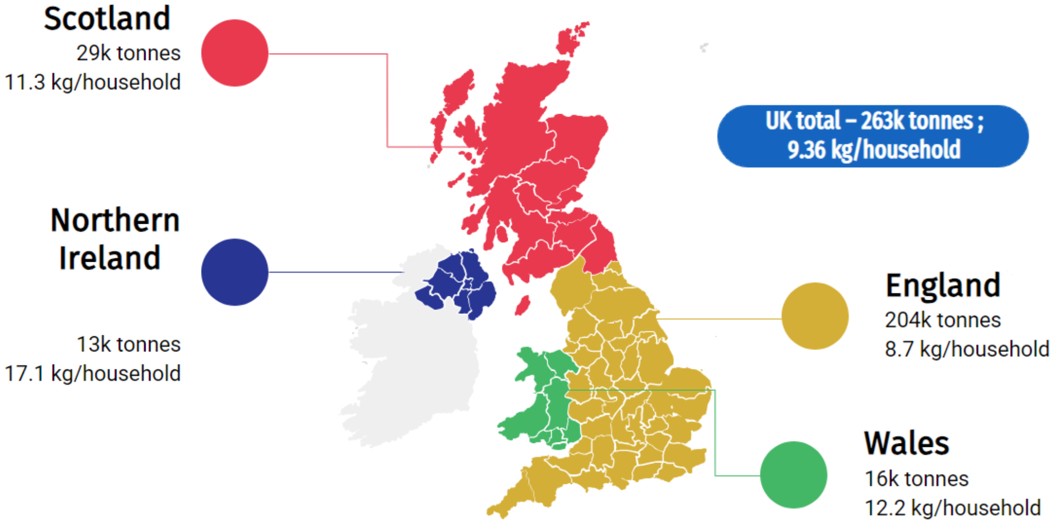


Figure 1 Household WEEE collected in the UK by local authorities for recycling by country (2021) excluding retailer takeback (Anthesis, 2023. This infographic has been created using publicly available information and data, and graphics from Slidesgo and Freepik).

Tonnage data has been obtained from SEPA (Scotland), Waste Data Flow (England and Wales) and DAERA (Northern Ireland) and household data has been obtained from ONS (England and Wales), NRS Scotland (Scotland) and NISRA (Northern Ireland).

The data from Northern Ireland has been interrogated because of the outlier results from the calculations. This study could not identify any reason as to why the apparent WEEE collected in this region per household is disproportionately higher than the rest of the UK in terms of the services available to households being materially different, or the Local Authority reported data being interpreted differently.

Waste over Time (WoT) is a model designed by Statistics Netherlands to determine the volume of EEE present in the economy and to identify at what time and in which quantities it is released as WEEE. By adapting the WoT model, it is possible to identify findings that show both *what* products, and *how much* product (by weight and quantity) are sold (placed on market), and stuck in the use, residence, retention and held unused stages of the life cycle. Those items commonly found in the home (Table 2) demonstrate that smaller and easily forgotten, or infrequently used, products are more prevalent. The focus moves away from the traditional weight-based metric to identify the quantity and type of typical items consumers have in the home. This now offers a better target for drawing these items out of the home into the correct reuse or recycling systems when they are discarded after first or second use, rather than being lost or stuck in situ.

Table 2 Top 10 products held unused (by unit) in 2021

Stocks: Held unused					
Top 10	**Stock held unused UK (units)**	**Product UNU key number[3]**	**Product description**	**Stock held unused UK (tonnes)**	**Average weight per unit (kg)**
1	24,083,447	201	Small Household Items (e.g. irons, clocks, adapters)	26,618	1.11
2	20,923,783	401	Consumer Electronics (e.g. headphones, remote controls)	8,160	0.39
3	20,888,486	306	Mobile Phones	1,880	0.09
4	10,722,697	506	Household Luminaires (e.g. light fittings, lamps, Christmas lights)	4,826	0.45
5	6,478,774	405	Speakers	13,865	2.14
6	6,415,745	205	Personal Care (e.g. toothbrushes, hairdryers, razors)	3,542	0.55
7	5,619,695	501	Portable Lighting (e.g. pocket or bicycle lights)	506	0.09
8	5,616,874	303	Laptops & Tablets	6,066	1.08
9	4,374,427	202	Food Preparation (e.g. toasters, grills)	14,311	3.27
10	4,318,769	502	Compact Fluorescent Lamps (e.g. desk lamps)	393	0.09

With these new results average material compositions and carbon measurements have been applied, to measure the impact of these commonly held unused products in homes and businesses. For example, there are ~6.4 million held unused personal care items in the UK. In electric shavers, hair straighteners, hair dryers and electric toothbrushes this equates to approximately 138 tonnes of lithium batteries and 814 tonnes of "plugs and wires" belonging to personal care items that are held unused.

Held unused (hoarded) products represent items that are not in-use but which are still in the household. In the case of plugs and wires, which make up a high proportion of the weight of personal care products, these items contain a significant amount of copper. Nearly 70% of worldwide copper produced is used for electrical/conductivity applications and communications. Copper can be recycled without any significant loss of performance[4] with recycled copper having lower CO2 emissions than virgin copper due to a lower energy requirement than primary production[5].

Extracting raw materials and manufacturing are two parts of the EEE value chain that are very carbon intensive processes. It is better, from a carbon saving perspective, to recycle existing products to enable the materials to be used again and to prevent the need to extract more material. Held unused items means this opportunity is missed. High-level analysis illustrates the scale of embedded CO2e footprints not recovered from products that are stuck in homes and businesses, which could be better handled if processed through

[3] https://i.unu.edu/media/ias.unu.edu-en/project/2238/E-waste-Guidelines_Partnership_2015.pdf

[4] https://copperalliance.org/resource/copper-recycling/#:~:text=Copper%20is%20100%25%20Recyclable,they%20can%20be%20used%20interchangeably.

[5] https://copperalliance.org/resource/copper-recycling/#:~:text=Copper%20is%20100%25%20Recyclable,they%20can%20be%20used%20interchangeably.

reuse and recycling channels. The embedded carbon footprint draws attention to items that are well recognised and commonly in the home but through consumer behaviour are not managed well. The CO2e footprints of commonly held unused items in UK homes ranges from approximately 65,953 tonnes (personal care items) to 1.4 million tonnes (laptops and tablets).

This study gives greater insights to what *types* of products have been sold (placed on the market) and can be found in homes and businesses. Further research opportunity lies in better understanding the latter stage of the value chain once users pass on or discard products; the composition of the 103kt of electricals in the residual waste and 498kt in WEEE recycling streams, and 349kt falling into light iron recycling. Filling these gaps in knowledge will help us understand the type of products that are going in the correct recycling channels, and which are the types of products falling into the wrong places.

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List of Abbreviations

AATF – Approved Authorised Treatment Facility

CO_2e – number of metric tons of CO_2 emissions with the same global warming potential as one metric ton of another greenhouse gas

DCF – Designated Collection Facility

EEE – Electrical and Electronic Equipment

EPR – Extended Producer Responsibility

EWC – European Waste Codes

Flows/Pathway – the movement of electricals through the product life cycle

Hoarded – Held unused

ITAM/ITAD – IT asset management & destruction

kt – kilo tonnes

LDA – Large Domestic Appliance

ONS – Office for National Statistics

PCS – Producer Compliance Schemes

POM – Placed on Market

SMW – Small Mixed WEEE

Stock – Electricals measured at a given point (during or after the product life)

UNU – United Nations University

WDF – WasteDataFlow

WEEE – Waste Electrical and Electronic Equipment

WfH – waste from households

Research background

Since the WEEE Regulations came into force, there has been a gap in the understanding between the weight of EEE sales and WEEE collection and treatment. Mapping of pathways of electricals has been carried out before but these have been higher level (e.g., Global e-waste monitor[6], or more targeted by product or geography (e.g., The Dutch WEEE Flows 2020[7]).

Other previous studies into the unreported reuse, collection, storage, treatment and disposal of WEEE have been published however these vary in scope and representation of current trends and behaviours. The last WEEE Flows update from Anthesis was in 2019 (published 2020)[8], but since then many factors have influenced the landscape of electricals.

This report updates the major flows of electricals on to and off the UK market, as well as providing added impact insights. Material Focus commissioned Anthesis, the Sustainability Activator, to support the reassessment of these key EEE and WEEE pathways to provide an up-to-date evidence base. This will support communications and subsequent research prioritisation, and supplement this with new insights across other impact metrics that demonstrate the scale of the challenge and opportunities to reuse and recycle more electricals, supporting a truly circular economy for electricals.

Anthesis is well versed in EEE and WEEE trends and has built on prior learnings from research in the Challenges and Opportunities report. This compliments more recent evidence, as well as findings from Material Focus own detailed investigations since 2020 within specific pathways and behaviours. The task was to integrate selected sources of new information and new supplementary market insights back into the context of measuring EEE and WEEE flow volumes and amounts.

[6] https://www.itu.int/hub/publication/d-gen-e_waste-01-2020/

[7] https://ewastemonitor.info/wp-content/uploads/2021/09/Dutch_WEEE_flows_ENGNL1.pdf

[8] https://www.materialfocus.org.uk/report-and-research/electrical-waste-challenges-opportunities-2/

Part 1; Refresh priority EEE and WEEE Pathways

Since the publication of Material Focus report *Electrical Waste - Challenges and Opportunities: An investigation into Waste Electrical and Electronic Equipment (WEEE) flows in the UK*, released in 2020[9], businesses and consumers have experienced great change, and this study aims to re-benchmark the current situation. The purpose of the research in Part 1 is to re-model key W/EEE pathways and provide new updated measurement of the volumes currently in the system.

The study uses a mixture of new and updated data sources, where available, to benchmark types and volumes of electricals as of 2021 (calendar or financial year). 2021 is the most recent year when comparable datasets are published or available for analysis. As the world returned to the new-normal after the COVID-19 pandemic, this study seeks to gather and analyse the most accurate data available and provide robust modelling to refresh these calculations.

New innovative approaches have been taken in several of the W/EEE pathways including:

- Placed on market (POM); new modelling has been undertaken, based upon United Nations University KEYS (UNU-KEYS) data points.
- Use, retention, hoarding and residence times; new modelling by SW Consulting based upon UNU-KEYS data points has been included.
- Illegal exports; calculations have been based upon new research from UNITAR.

The remaining pathways have adopted the same methodology as the previous study but updated the data inputs to these calculations to reflect 2021 as a baseline year. The advancement of knowledge in these pathways is offered through more recent or improved accuracy of data brought together to better understand activities involving electricals.

There are 8 priority pathways that have been 'refreshed' as part of the project, with the latest or new information that has improved the relevance of that contributor to the overall EEE and WEEE (W/EEE) eco-system. These were selected and agreed based on materiality to the overall system, as well as the importance to Material Focus' role in shifting stakeholder understanding of the challenges surrounding consumption and disposal of electricals.

Additional insight and information have been gained from industry stakeholders including producers, retailers, WEEE producer compliance schemes (PCS's), Local Authorities, Waste Management companies and recyclers, Anthesis in-house waste experts, and aggregation of Material Focus' own prior research. A summary of these updates is presented in Table 3.

[9] https://www.materialfocus.org.uk/report-and-research/electrical-waste-challenges-opportunities-2/

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Table 3 Summary of W/EEE Pathways updates published 2020 vs 2023

		2020 publication				2023 publication	
	Electricals Stream	Estimated volume	Confidence	Approach or evidence base	Researcher	Estimated volume	Confidence
In use retention hoarding flow (EEE)	Use, retention, hoarding	1499	Medium	Data updates, increase product coverage & WoT model refinements (w/Small World Consulting, Lancaster)	Anthesis (w/Small World Consulting, Lancaster)	2,195kt entered and 1,870kt exited this use/ retention/ hoarding stage resulting in a stock in first use of 17,807kt (=6.8b units) in homes & businesses.	Med-High
Reporting variances flow (EEE)	Free riders - unreported EEE	46	Medium	Same % of POM methodology	Anthesis	61kt	Med
Recycled destroyed and exported flows (WEEE)	via AATF	653	High	WEEE reported by AATF (gov.uk)	Anthesis	498kt	High
	via light iron	215	Medium	Same methodology with multiple sources updated	Anthesis	349kt	Med-High
	Residual waste	155	High	Primary data waste comp 2021 with Waste Data Flow, SEPA, Stats Wales & DAERA	Anthesis (w/AHK Group, Birmingham)	98-107kt	Med-High
	Theft	114	Medium	Same methodology with updated data estimate	Anthesis	148-164kt	Med
	IT asset managed	90	High	Same methodology with updated data estimate	Anthesis	72-123kt	Med-High
	Illegally exported	32	Medium	Updated evidence; new e-waste monitor report with UK market share estimate	Anthesis	187kt	Med

This research demonstrates there is a growing gap between POM and collected for recycling and looks to quantify some of the major pathways where these electricals are going. It is hoped this will inform where future actions could be focused to maximise the impact of improved awareness and behaviour change campaigns for better use and disposal of electricals.

Since the previous study there have been some notable movements in estimated volume W/EEE pathways as new information evidence and modelling becomes available. This section of the report explains the refresh calculation and results.

1. Use, retention, residence, hoarding

Various types of household EEE are likely to be used daily, regularly or occasionally, stored for possible future use, held for an emotional or sentimental value, or hoarded without an apparent intention of future use. Depending on the type of product (EEE), the regularity of use is likely to affect the product's chances of being retained and/or redeployed in a household, which has obvious implications for the time it takes to arise as WEEE.

Methodology

The assessment for use, retention, residence and hoarding has used an innovative approach to estimating the volumes and types of products being placed on the market in the UK. This updated methodology and comparison with the previous assessment means it is possible to develop a more detailed picture of what is in consumers' homes and businesses as well as the change by year. The research for this part of the project was led by Small World Consulting Ltd utilising the Waste Over Time model developed by Statistics Netherlands to help determine the physical weight of sold electricals and the waste generated as a result. This tool involves implementing the 'apparent consumption method', and the 'sales lifetime approach' which means estimating physical sales by adding domestic production to imports and subtract from this the exports. The weight of these sales was integrated with the profile of expected lifespan of electronic and electrical equipment. Data is derived from European production and trade statistics which holds greater opportunity for wider research applications.

Use, hoarding and retention flow of electricals is measured from the point a product is POM (akin to sales), the time in use and residence/retention and hoarding, before flowing into a second life pathway or waste disposal stage. At each level volumes and quantities are assessed. The interconnected flows and stocks simulated by the updated model are illustrated in Figure 2.

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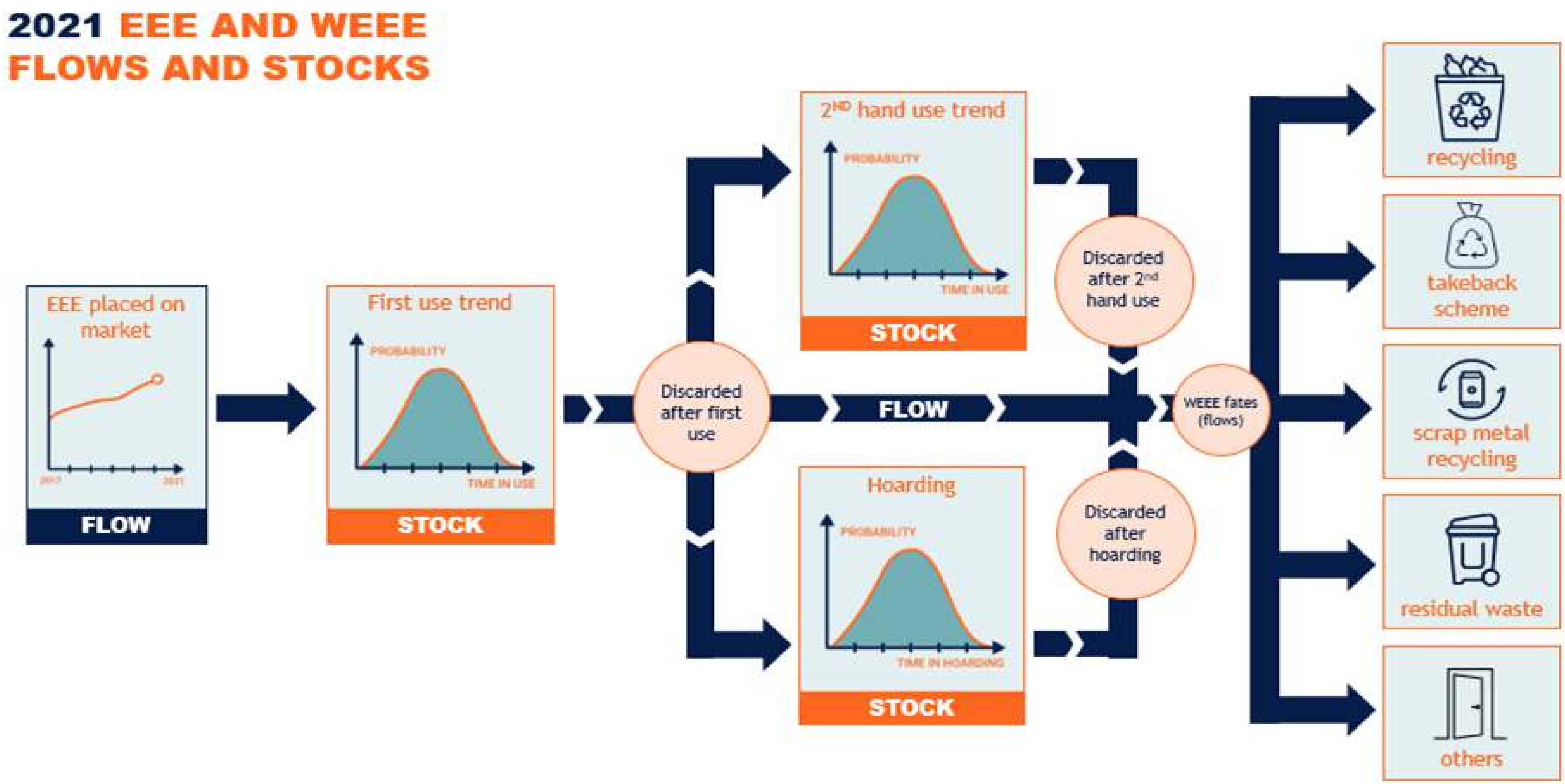

Figure 2 Stocks and flows relationships and distribution model (Anthesis, 2023).

Overview of the new results

The new analysis produced the following estimates for EEE and WEEE flows in 2021:

Inputs – POM volumes[10]:

- 2,195kt of new EEE was purchased (we use this as an equivalent to POM).
- 1,873kt of the previously purchased EEE got discarded after first use, finding the way into multiple EEE and WEEE streams.
- Of the items discarded after first use, 83kt entered into second-hand use and 214kt entered into hoarding.
- 79kt of the items that had previously entered second-hand use got discarded, finding the way into multiple WEEE streams.
- 207kt of the previously hoarded items got discarded, finding the way into multiple WEEE streams.
- In 2021 the rate of change for;
  - the quantity of electricals (stock) in first use grew by 322kt.
  - the quantity of electricals (stock) in second-hand use grew by 3.1kt.
  - the quantity of electricals (stock) in hoarding grew by 6.8kt.

Stock – what can be found in homes & businesses now, but has not yet been discarded:

- The first use stock amounted to 230 items per household (around 6.8 billion items for the whole of the UK).
- The second-hand stock amounted to 2.8 items per household (around 80 million items for the whole of the UK).
- The hoarded stock amounted to 4.6 items per household (around 131 million items for the whole of the UK).

Discarded – product that becomes waste:

- Total WEEE generated was 1,863kt.
- The biggest WEEE flows were "Recycling" (721kt), "General bin" (777kt) and "Other" (286kt; mostly scrap metal).
- The estimated top 10 products in 2021 associated with hoarding and POM are summarised in Appendix III.
- The estimated total EEE and WEEE stocks and flows between 2017 and 2021 are summarised in Appendix III.

2. Residual Waste

Residual waste, often referred to as "black bag waste" is waste that has not been separated and cannot be recycled or reused. Residual waste tends to be sent to energy recovery (incineration) or landfill. In most UK local authorities, household residual waste is collected at the kerbside, via a special bulky uplift, or it can be taken to a Household Waste Recycling Centre (HWRC). While WEEE *should* be collected separately so that it can be handled and treated appropriately and recycled, a proportion of WEEE still ends up in residual waste, meaning that these items are not recycled and

[10] see note on differences to government published records p.43

that their value is lost.

Methodology

Official statistics on waste generated in the UK are reported by Defra[11], including waste from households (WfH) which is the agreed harmonised UK measure used to report household recycling. The UK currently defines 'household waste' using the WfH measure[12]. While the official statistics on waste are reported by Defra, more detailed "raw data" is also available for England, Scotland, Wales and Northern Ireland:

- England – data for England is available from WasteDataFlow (WDF)[13], which is the web-based system for municipal waste data reporting by local authorities to the government[14].
- Scotland – data on the generation and management of household waste is available via SEPA's Scottish Household Waste Discover Data Application[15].
- Wales – data on annual waste generated (tonnes) by source is available from StatsWales[16].
- Northern Ireland – local authority collected municipal waste management statistics are available from DAERA[17].

In addition to the above data, the number of households in each area was obtained. Household estimates are available from Census data and can be accessed from the Office for National Statistics (ONS)[18] (England and Wales), National Records of Scotland[19] and Northern Ireland Statistics and Research Agency[20].

Waste composition analysis of WEEE fractions in residual waste was taken from household waste deposited through sample households in defined local authority regions in England and uplifted to the rest of England, Scotland and Northern Ireland. Waste composition data for Wales was available from a recently published report from WRAP Cymru[21].

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[11] https://www.gov.uk/government/statistics/uk-waste-data/uk-statistics-on-waste

[12] https://www.gov.uk/government/statistics/uk-waste-data/uk-statistics-on-waste

[13] https://www.wastedataflow.org/home.aspx

[14] WasteDataFlow also provides raw data from local authorities for the other UK nations, however, given the compositional sampling data only covered England, a regional breakdown for England was required (as available from WasteDataFlow), whereas, only national figures for Scotland, Wales and Northern Ireland were needed rather than a local authority breakdown

[15] https://informatics.sepa.org.uk/HouseholdWaste/

[16] https://statswales.gov.wales/Catalogue/Environment-and-Countryside/Waste-Management/Local-Authority-Municipal-Waste/annualwastegenerated-by-source-year

[17] https://www.daera-ni.gov.uk/publications/northern-ireland-local-authority-collected-municipal-waste-management-statistics-time-series-data

[18] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/populationandhouseholdestimatesenglandandwales/census2021unroundeddata

[19] https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/households/household-estimates/2021#:~:text=The%20number%20of%20households%20in,dwellings%20in%20Scotland%20in%202021.

[20] https://www.nisra.gov.uk/publications/census-2021-population-and-household-estimates-for-northern-ireland

[21] https://wrapcymru.org.uk/resources/report/compositional-analyses-municipal-waste-and-litter-wales

Overview of the new results

The analysis found that the tonnage of WEEE in household residual waste has decreased since the previous study. This could be driven by behaviour change interventions and/or be a result of sampling and the availability of robust representative data. Waste composition programmes are carried out across the UK at periodic intervals and add to the recent Welsh data.

Compositional waste data assessing the fraction of WEEE included a sample of households in 6 out of the 9 regions of England. In addition to this sampling, in July 2023 WRAP Cymru published a report on the composition of household waste across Wales, with the compositional analysis being carried out in all 22 Welsh local authorities and taking place over two seasons – summer and winter in 2022. This study aggregates both data sources (with a total of 68 individual local authorities being sampled in total) to determine a UK average.

Table 4 Overview of the amount of WEEE found in residual waste in the UK

	Total annual tonnage of UK residual waste arising	Total tonnage of WEEE arising in UK residual waste	Average percentage composition of WEEE in residual waste in the UK
2023 update (2021 data)	15,330kt	103kt	0.67%
2020 study (2017 data)	16,711kt	155kt	0.93%

As outlined in Table 4 the total tonnage of WEEE arising in UK residual waste in 2021 was 103kt, meaning that the average percentage composition of WEEE in residual waste in the UK was 0.67%. A high-level approach (composition data applied to the residual tonnage) was also determined along with a detailed bottom-up approach applying the detailed compositional analysis to the raw data and scaling this up for the UK. These two methods gave a range of 98kt – 107kt of WEEE arising in UK residual waste (0.64 - 0.70% of residual waste).

The decreased volume of WEEE in the residual waste stream is a result of the reduced amount of WEEE found in household bins and general waste. Total residual waste arisings data again came from nationally published data, to which the percentage WEEE fraction was applied. This total volume experienced an 8% decrease (16,711kt down to 15,330kt).

The sampling evidence provided by AHK Group, of WEEE in the residual waste, offers a good level of household representation across England and supplemented by additional research published for Wales; although no samples were available for Scotland[22] and Northern Ireland[23]. This is only the second time this WEEE in residual metric has been calculated in this way, so it is still early to determine the true UK wide representation. The main variable of this comes from the waste composition sampling rather than the total residual waste arising which has the same coverage and source of evidence. In any future iteration of this study, improvements can be made by widening the composition sampling to give greater recognition of differing local authority collection services (e.g.,

[22]It is noted that Scotland has a current waste composition analysis programme - https://www.zerowastescotland.org.uk/resources/waste-composition-analysis-programme-2021-2024 A previous study carried out in Scotland assessed the composition of household waste at the kerbside in 2014-15

[23]Previous data dates from 2017 https://www.daera-ni.gov.uk/publications/northern-ireland-kerbside-waste-composition-2017-summary-report-volume-1

kerbside WEEE collection), rurality (cities, suburban, rural) and household type (various metrics like building type, socio-economic measures) which to a greater or lesser extent may impact WEEE disposal behaviours.

3. Free-riders

The name Free-riders is recognised by enforcement bodies and most EEE stakeholders as 'producers who are not compliant with the relevant Extended Producer Responsibility (EPR) laws'. In this instance, for failure to register and report products placed on the market under The Waste Electrical and Electronic Equipment Regulations 2013, SI 3113 (as amended)[24].

The number of players who knowingly and unknowingly are failing to meet their legal obligations and avoiding their share of the waste recycling costs, places an unfair advantage over those producers who *do* register, report and finance the recycling of waste electricals.

Methodology

The methodology used to calculate the tonnage of free-riders is the same in this report as the previous 2020 report, but with updated input sales data.

The total EEE POM and total WEEE registered (Environment Agency statistics) in 2021 were used to determine the total amount of unregistered and exempt/unaccounted for WEEE and using the same assumptions as in the previous report for the proportions of free-riders in each category.

Overview of the new results

The total tonnage of free-riders in 2021 was estimated to be 61kt.

The latest calculation for the volume of EEE not recorded in the official statistics published by the government[25] is based upon an update of the latest records available of current producer reporting, plus an estimated percentage non-reported volumes which came from a variety of industry experts. The calculated figure is believed to be a low estimate of the total scale of the problem. Some evidence from prior research led by Eucolight[26] has indicated smaller products are more susceptible to this problem, compared to traditional retail models. The scale could be bigger as a result of the increasing prevalence of online marketplaces[27] (ecommerce and platforms with 3rd party sellers) with remote drop shipment distribution in the UK, and international sellers operating remotely who are more difficult (if not impossible) to regulate under UK EPR laws as well as potentially being less aware of these requirements.

For the scope of this research, e it has been estimate that 61kt of EEE is placed on the market without being reported via official producer EPR systems. The context of the outcome is set against the 1,922kt that was reported by producers in 2021[28].

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[24] https://www.legislation.gov.uk/uksi/2013/3113/contents/made

[25] https://www.gov.uk/government/statistical-data-sets/waste-electrical-and-electronic-equipment-weee-in-the-uk

[26] https://www.eucolight.org/publications/open-letter-to-the-parliament-of-the-european-union-stop-sale-and-imports-of-illegal-products-via-online-marketplaces/

[27] https://store.mintel.com/report/uk-online-retailing-marketplaces-and-peer-to-peer-selling-market-report

[28] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1160182/Electrical_and_electronic_equipment_placed_on_the_UK_market.ods

4. Via AATF (WEEE recycling)

Approved Authorised Treatment Facilities (AATF) represent WEEE that has been reported via the Agencies accredited recycling channels and has been financed through WEEE producer fees for organisations registered under The Waste Electrical and Electronic Equipment Regulations 2013.

Methodology

This data is compiled and published quarterly by the Environment Agency and covers the whole of the UK. The volumes reported as received by AATF (where obligated) count towards the UK WEEE recycling target. This target has been missed in consecutive years, and the data presented here shows how it has tracked since the previous Material Focus WEEE Flows study that was based upon 2017 recycling rate performance.

Overview of the new results

The UK has struggled to demonstrate any major shift in the volumes being received by AATF. Even considering the irregularities caused by COVID, the decline in WEEE collected has been steady and consistent, with our latest result showing 498kt of WEEE received by AATF in 2021. Figure 3 illustrates the main WEEE streams received at AATF, excluding lighting and PV panels.

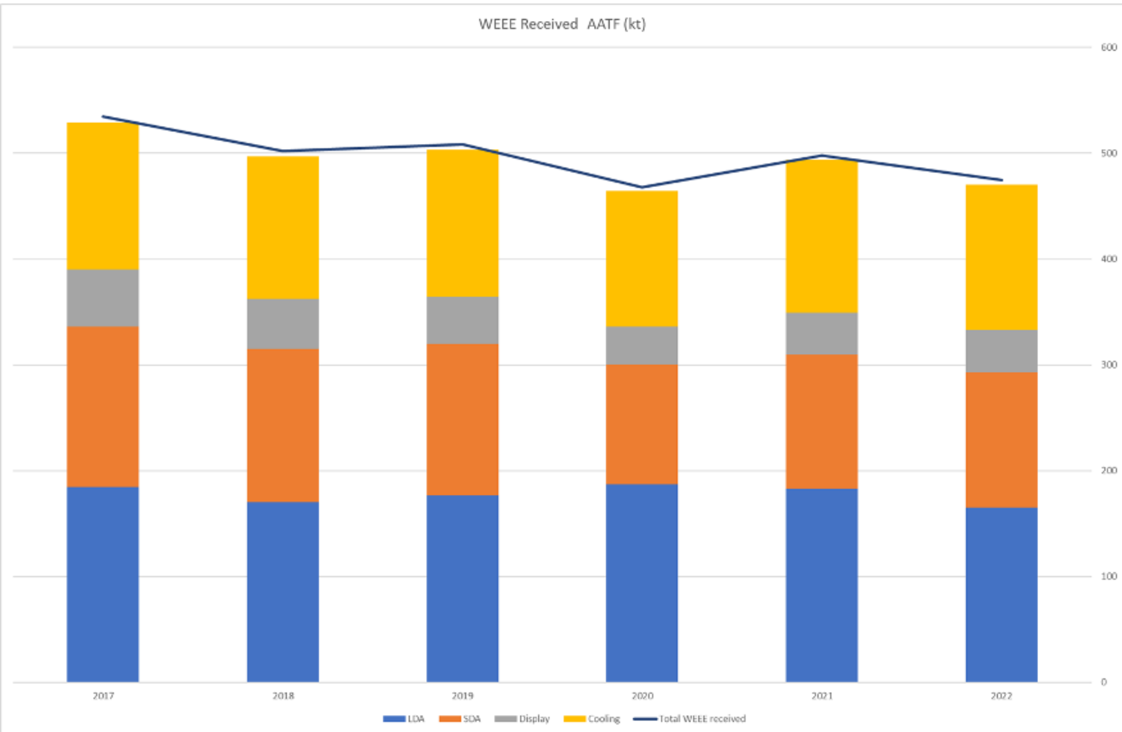


Figure 3 WEEE collected by AATFs ([Environment Agency, 2023]).

Diving a little into the sources of this, the study looked to the collection origins. The options available in statutory reporting through the WEEE system show us the following breakdown, with Regulation ('Reg') making reference to the Regulation stipulating the type of collections for reporting (see Figure 4).

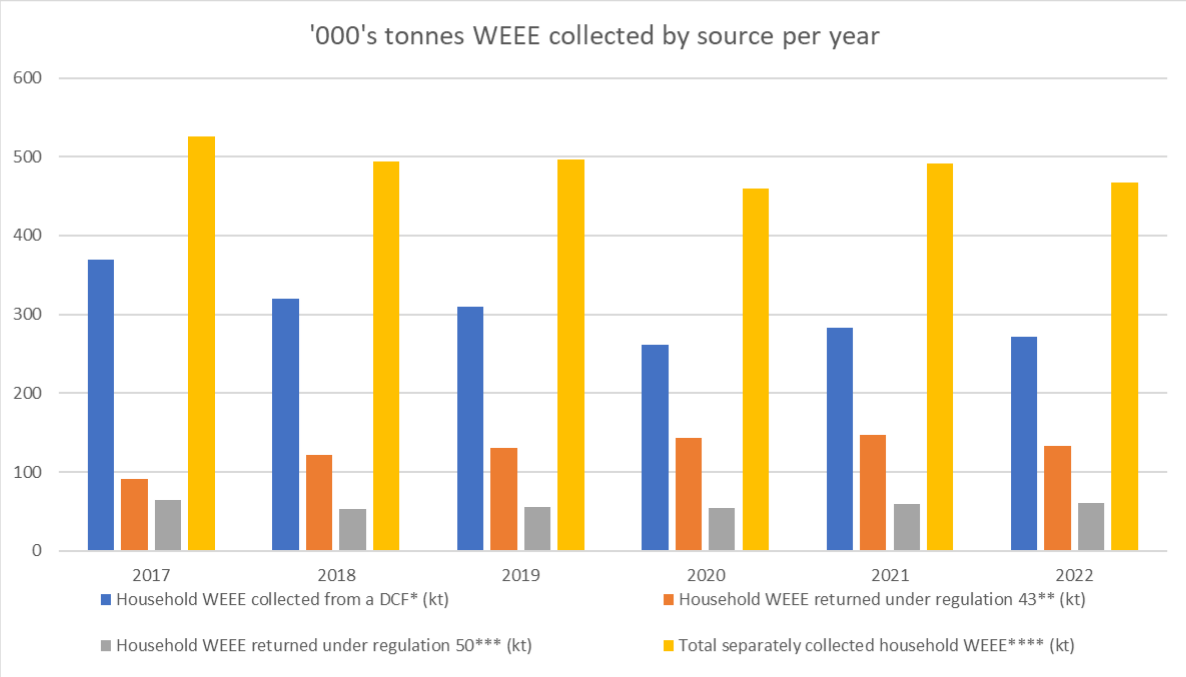


Figure 4 Tonnage of WEEE collected by source per year (Environment Agency, 2023).

** Collected DCF: This figure includes household WEEE from Designated Collection Facilities (DCFs) that has been collected by Producer Compliance Schemes (PCF), and household WEEE that DCFs have cleared themselves*

*** Reg 43: This figure includes household WEEE returned by distributors to PCS.*

**** Reg 50: This figure includes household WEEE collected through a collection system a PCS operates itself.*

***** Total household WEEE collected: This figure is the amount of WEEE PCS's have reported as being delivered to AATF and Approved Exporters on their behalf.*

Figure 4 examines the gradual decline in household WEEE collected by collection system (total separately collected household WEEE), which is mostly fuelled by a lack of WEEE coming back into DCF's. It also highlights the slight increase up to 2021 for WEEE returned to distributors (retailers) collection systems, however this has appeared to have peaked. Given the retail trend destabilisation caused by COVID-19 lockdowns, it is not possible to see any recent trends from reported data.

5. Light Iron

Material commonly called 'Light Iron', refers to steel scrap 5C loose old light domestic material. Light iron is a scrap metal that holds a positive value so despite the mixed nature of origins, there is reason to separate these metal rich materials. Material is often a mixed metal composition and is considered by industry to be the (non-product specific) waste stream where most WEEE may find itself once it has been collected by waste management organisations. Those treating light iron may or may not be AATF, however the WEEE fraction is lost from reporting amongst mixed scrap metal.

Methodology

The methodology for the Light Iron calculation builds on an earlier model from Valpak EEE flows studies in 2016[29] and 2018[30], but revises the major contributing inputs to their model with new data.

The light iron flow can be broken down into the following sub-flows:

- DCF mixed scrap.
- Small Mixed WEEE (SMW) and display equipment from AATFs.
- End of Life Vehicles.
- Separately collected Large Domestic Appliances (LDA) at a DCF site.
- All other sources.

The combined total of the above sub-flows gives the total light iron in-feed to a shredder.

This study has used published data sets from various sources (see Appendix I for a detailed breakdown) and applied these to the flow model to determine how much LDA WEEE is likely to be processed within Light Iron recycling.

Overview of the new results

The analysis found that 349kt of LDA are in light iron (Table 5). In comparison to the previous Material Focus study, the contributing input that is uplifting this volume from 215kt to 349kt appears to be the revised calculation of light iron in-feed (Table 5). This originates from site reported volumes selected metal processing most likely to include light iron fractions. This relies on accurate site reporting and classification of metal waste by European Waste Codes (EWC) codes without double counting.

Table 5 Light Iron flows and the amount of LDA found in Light Iron

Activity/Flow	Comment	2021 Update (kt)
DCF mixed scrap	Removed from total LDA in light iron	271
Small mixed WEEE and display equipment from AATFs	Removed from total LDA in light iron	78
End of Life Vehicles	Removed from total LDA in light iron	1,310
Separately collected LDA at a DCF site	Removed from total LDA in light iron	165
All other sources	Assumed to contain 11% LDA not accounted for elsewhere	3,176
Total Light iron in-feed to shredder	Estimated using England's EA WDI (2021) and Wales' NRW (2021) data	5,000
Total LDA in Light Iron	**11% of all other sources**	**349**

To bench test the data, the study contrasted calculated LDA in light iron against the previous estimate and the correlation to average published prices for Light Iron[31]. Light iron is defined as

[29] https://www.valpak.co.uk/knowledge-hub-post/eee-flow-2016/

[30] https://www.valpak.co.uk/knowledge-hub-post/eee-flow-2018/

[31] https://www.letsrecycle.com/prices/metals/ferrous-metal-prices/ferrous-scrap-metal-prices-2022/

Grade 5c ferrous metals, loose old light steel[32]. This may consist of depolluted motor cars, white goods and old light iron and steel arisings. It must not include heavy iron and steel, wire ropes, wire, fuel tanks, or tin coated materials and loose or free dirt or tyres. Figure 5 illustrates the comparison of LDA that are materially susceptible to leaking into the light iron stream due to their physical characteristics.

The volumes of LDA collected (Figure 5) charted against approximate light iron Grade 5C value do show some degree of inverse correlation. However, from a high level there is less of a relationship post-pandemic, as commodity values have risen. Stakeholders traditionally suggest there is an inverse relationship to WEEE collected for recycling; when the price of light iron Grade 5c goes up, the volume of metal rich WEEE reported through AATF received WEEE goes down. The application of this theory would indicate a varying risk of WEEE in light iron being processed through these alternative channels and tests the question 'Has the increase in light iron been supported by a reduction of LDA collected and increase in light iron 5c value?'.

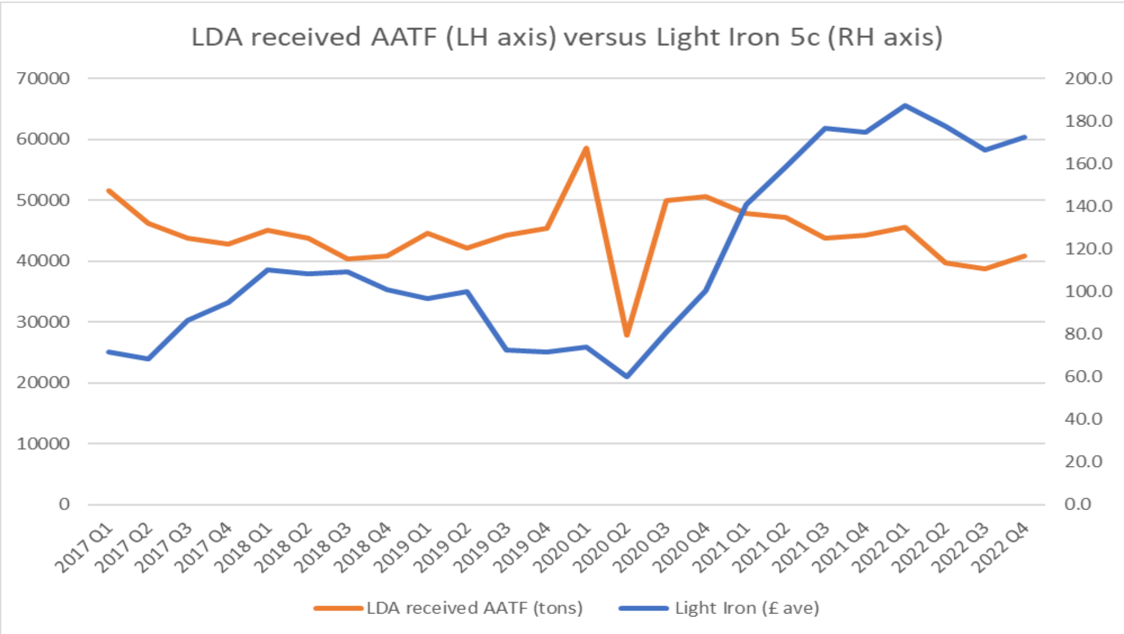


Figure 5 Comparison of LDA that are materially susceptible to leaking into the Light Iron stream due to their physical characteristics.

When comparing the price in 2017 ~£70/tonne (Material Focus previous study) versus the prices in this piece of research based on 2021 ~£170/tonne, the difference is notable. This is believed to be a contributing factor as to why there has been a large increase to the 349kt calculated in this research update.

Deeper economic and material analysis would be required to support or challenge this theory for increased WEEE in light iron, however the dynamic short-term factors appear to have weakened this

[32] https://www.letsrecycle.com/prices/metals/ferrous-metal-prices/ferrous-grades/#:~:text=Grade%205C,or%20free%20dirt%20or%20tyres.

traditional view, for now.

6. Theft

These flow reports are broken down into the main product groups (LDA, cooling equipment, SMW and displays) that are most susceptible to theft from the WEEE system. Each has its own set of unique factors that require individual consideration as part of the wider estimate on the total amount lost from the system (see Appendix II).

Methodology

The research builds on previous work for the Material Focus study of Theft that was carried out in partnership with REPIC and Valpak Consulting in 2019. The model remains consistent in its approach but updates some data source inputs that are more recently available or updated. Elements that are consistent in the calculation include:

- Breakdown of major WEEE streams susceptible to theft (LDA, SMW, Cooling and Display).
- Consistent ratios applied e.g., CRT vs flat screen, and product trends (e.g., life-span to determine lag from POM to disposal).
- Component loss rates is still applicable in 2021 as applied to 2017 baseline data study (although untested in this study, there could be a correlation linked to material values that influences rate of component theft).

Overview of the new results

The refresh of stream specific data sources provided a new picture for the estimated incidences of theft and the resulting volume of WEEE lost from official collections, as presented in Table 6.

Table 6 Volume of WEEE lost from official collections.

Category	2017 report (tonnes)	Refresh calculation 2021; Total weight lost to theft (tonnes)	
		Value #1 (min)	Value #2 (max)
Large Domestic Appliances (LDA)	89,671	106,232	
Cooling Equipment	7,758	11,925	
Small Mixed WEEE (SMW)	3,201 - 5,335	5,271	8,785
Displays	12,118	25,145	37,708
Total	**114,882**	**148,574**	**164,650**

The overall shift correlates to changes seen throughout on the continued divergence between POM and WEEE collected data, and are the major drivers to the changing volumes. Not all of this differentiation follows the theft pathway. Data assessed in the research project does show that by weight at least, there are more unaccounted for electricals than previously attributed to the overall EEE and WEEE flows since the 2017 baseline data year previously assessed.

The theft calculation does try to mitigate the weight-based shortcomings that do not recognise some physical characteristic changes that the electricals market has demonstrated. This is most evident in the cooling and display calculation to try and recognise some variation when applying average unit weight to the total weight-based metrics. This further adds to the robustness of the methodology allowing for a potential variance in the outputs.

The indication of the increases in volume of electricals lost to theft could be further compounded by looking at a possible route to disposal if theft of products ends up in the hands of the scrap metal sector. This would appear to be at least in part driven by economics of metal prices. The ~£100/tonne price increase in scrap metal price since the previous study would significantly influence the market and prove as a driver for economic gain through theft.

Another route pathway for electrical lost to theft, as suggested by stakeholders, is resale, which could be more prevalent in the display and possibly LDA streams. Industry stakeholders as well as those operating in the re-use market echo the same message, that there is increasing demand for quality working used 'big ticket' (i.e., expensive if purchased new) electricals such as washing machines and TVs. It is believed that this is driven by wider economic challenges and demand from those households with lower incomes; and that this series of characteristics are compounding to create a market opportunity that could drive more electricals away from formal recycling channels e.g., AATF WEEE recyclers.

The notable increase on display waste stream could warrant further investigation due to the dynamic behavioural trends behind this product group. Correlation with hoarding, consumer behaviour for infrequently used products, and lifespan may have more impact than the traditional modelling has recognised. This study takes a simplistic approach to the re-calculation, continuing with previous trends focusing on the switch over from CRT to flat screen and up-sizing replacements. This study suggests that this is not as prevalent as when carried out on 2017 data based on feedback from industry. Although it is still a contributing factor, other consumer use related factors are likely to be more material in determining the true number of products remaining in the home or discarded.

7. IT Asset management

IT asset management and destruction (ITAM/ITAD) is a sector that has grown out of servicing predominantly business users to release maximum value (and sometimes supply equipment as well) of telecoms, IT equipment and infrastructure during and after the products initial use phase. Operations include collection, repair, recovery and re-use of electricals.

The global marketplace demand for IT and technology from alternative sources has been spurred on by recent supply chain issues, most publicly recognised in the example of silicone chipsets and modules peaking during 2020-2021, and changes in working patterns enforced during COVID lockdowns and the lag that has remained.

Further exaggerating the demand for used product is the prominence and market access refurbishing organisations selling direct to consumers, along with sufficient consumer demand (and acceptance of used products). This could be a sector that sees future growth in addition to more traditional ITAM operations with changing consumer perceptions and more circular business models using lease type arrangements typically most common for high value IT and telecoms products. Success stories are evident in BackMarket, Recommerce, doctibike alongside more traditional resale platforms like eBay bringing together specialist refurbishment organisations with household consumers[33]. Small scale research samples[34] have already indicated the willingness of consumers to buy used, and this becomes more apparent with the quick turnover of the latest tech. The latest and greatest tech will always be more expensive, so to combat the increasing costs of these products, conflated most recently by more conscious consumer spending, more users appear to be starting to consider second hand electricals based on price and relative performance upgrade[35].

Methodology

In modelling the scale of this opportunity, this study has taken the previous baseline data from 2 earlier studies and contrasted that with stakeholder feedback from retailer and ITAM representative interviews. An interview was undertaken with an asset management representative who estimated the market size which we correlated with an average product weight to calculate total market size.

Overview of the new results

The median mass for a unit of IT equipment (excluding accessories, i.e., mouse, camera, etc.) was 5.355kg. The results are very similar in both reaffirming the earlier study results as well as the future potential growth. The growth of the sector is based on ITAM growth article[36] and benchmarked against other studies to test its representation. Applying the 6-8% CAGR market growth provides the basis for estimated growth up to 2021.

Table 7 illustrates these 3 models which has returned a total volume estimate of 72-123kt of W/EEE passing through the ITAD sector.

Table 7 Total volume of WEEE passing through ITAD sector.

Source	Volume estimate (Baseline year)	Min CAGR	Min volume 2021	Max CAGR	Max volume 2021
Annual growth uplift on Valpak method	57kt (2018)	6.4%	68.7kt	8.1%	72.0kt
Annual growth uplift on Anthesis method	90kt (2017)	6.4%	115.4kt	8.1%	122.9kt
Stakeholder estimate	80-107kt (2021)	-	-	-	80-107kt

8. Illegally exported

The nature of illegal activity, being hidden, makes this volume very difficult to estimate and to verify other previous estimates. Studies that have gone before have made estimates based on tracking samples of WEEE deposited in collection and takeback systems[37] and even receiving ports in Africa,

[33] https://www.edie.net/second-hand-tech-could-2023-be-a-tipping-point-in-the-markets-growth/

[34] Victoria Pérez-Belis, Marta Braulio-Gonzalo, Pablo Juan, María D. Bovea, Consumer attitude towards the repair and the second-hand purchase of small household electrical and electronic equipment. A Spanish case study, Journal of Cleaner Production, Volume 158,2017, https://doi.org/10.1016/j.jclepro.2017.04.143.

[35] https://www.euronews.com/next/2022/12/15/good-for-the-planet-good-for-your-pocket-the-second-hand-tech-market-is-more-in-demand-tha

[36] https://itassetmanagement.net/2022/06/28/global-itad-market-up-7-4-over-next-decade/

[37] Puckett et al., Basel Action Network, Holes in the Circular Economy: WEEE Leakage from Europe, (2019).

to estimate the scale of the issue[38]. UK Parliamentary reports[39] have failed to present a consensus of the size even after industry engagement, but they all recognise it is happening and is likely to be significant – some estimating 40% WEEE is illegally exported.

Methodology

Since the original estimate (previous Material Focus study), new estimates have been made by Unitar researchers as part of the Global Transboundary E-waste Flows Monitor 2022[40]. This Anthesis research project has used the Unitar study as a baseline because it was found to be the latest and most accurate global estimate available at this time. By extracting data representing Europe from this study and calculating the UK contribution to illegal waste movements, this study has estimated the total volume of illegal waste movements applying extra Eurostat and UK EEE POM data.

Overview of the new results

Figure 6 summarises the application of the data used in the estimate of illegal exports of WEEE leaving the UK.

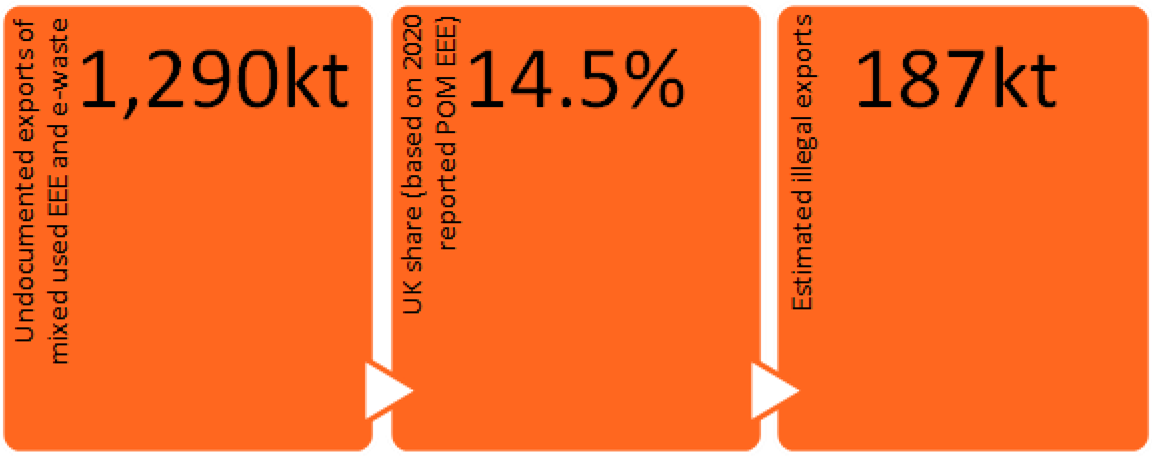


Figure 6 Estimated volume of illegal exports of WEEE leaving the UK.

This simple model assumes that each country is susceptible to the same degree of illegal waste movements. However, it is recognised that differing interpretations and administration in managing movements of used electricals versus waste material and variable border control will be a factor. These are unmeasured for the purpose of this calculation. The 2022 published Global e-waste

[38] Odeyingbo, Olusegun, Nnorom, Innocent and Deubzer, Otmar, Person in the Port Project: Assessing Import of Used Electrical and Electronic Equipment into Nigeria. UNU-ViE SCYCLE and BCCC Africa., (2017), p 35

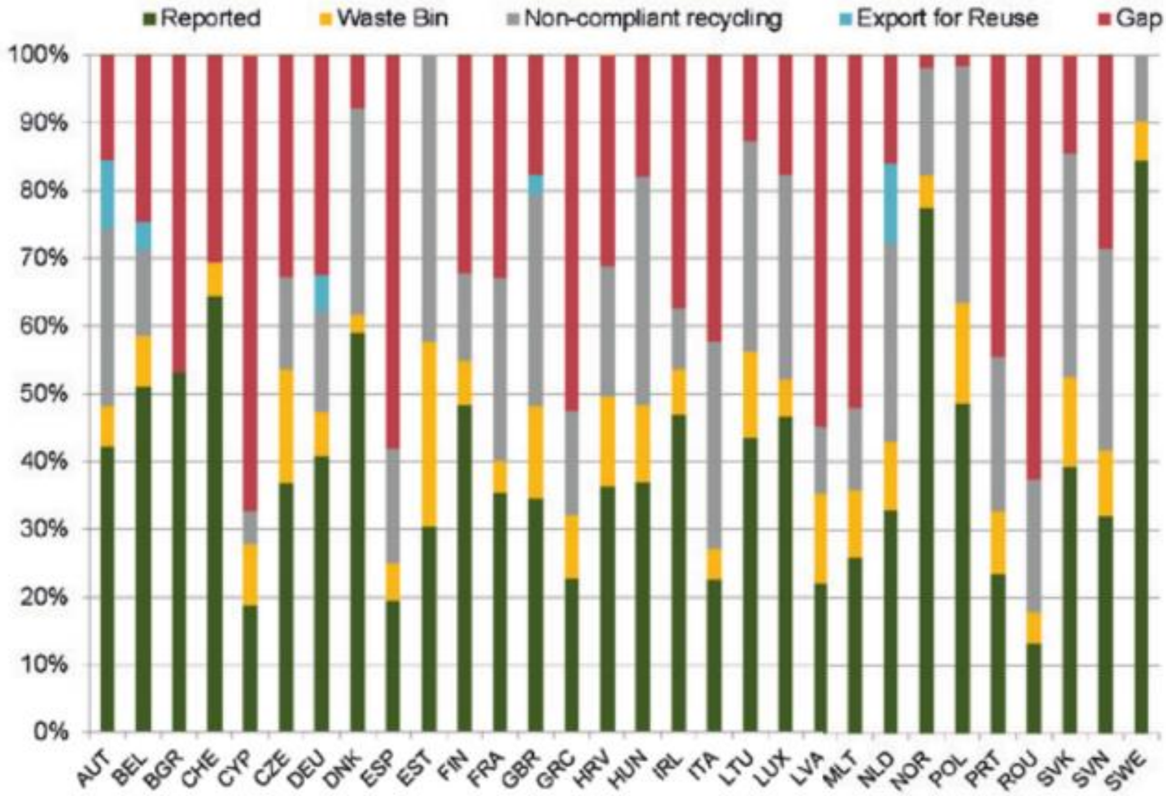
[39] https://committees.parliament.uk/publications/3675/documents/35777/default/

[40] C.P. Baldé, E. D'Angelo, V. Luda O. Deubzer, and R. Kuehr (2022), Global Transboundary E-waste Flows Monitor - 2022, United Nations Institute for Training and Research (UNITAR), Bonn, Germany

Transboundary study[41] was used as a baseline estimated. This deeper research considered more countries and calculated 1,290kt of illegal movements across Europe. Clearly this is still a significant volume across Europe of which the UK has taken a share.

Varying levels of enforcement will also impact the likelihood of illegal activities. A counter measures study involving INTERPOL took place from 2013-2015. The final results[42] published in 2015 (see Figure 7, taken from this research for comparison of 'gap' unknown whereabouts of WEEE based on this 2012 published research) matches extrapolated data from IMPEL on export ban violations, indicating 250kt as a minimum and 700kt as a maximum of illegal e-waste shipments across the EU. Comparing this 2015 estimate to the 2022 estimate of 1,290kt and considering the growth rate of consumption of electricals, the baseline figures are considered robust.

Figure 7 Illustration from study 'Countering WEEE Illegal Trade (CWIT) Summary Report' (2015).



Summary of WEEE Flows Refresh

The apparent changes in these flow estimates represent a new benchmark to better understand the true challenge and opportunity facing the electricals system. The study has shown that there are still

[41]C.P. Baldé, E. D'Angelo, V. Luda O. Deubzer, and R. Kuehr (2022), Global Transboundary E-waste Flows Monitor - 2022, United Nations Institute for Training and Research (UNITAR), Bonn, Germany

[42]Huisman, Jaco & Ioana, Botezatu & Herreras, Lucia & Liddane, Mary & Hintsa, Juha & Luda, Vittoria & Leroy, Pascal & Vermeersch, Elise & Mohanty, Sangeeta & van den Brink, Susan & Ghenciu, Bogdan & Dimitrova, Denitsa & Nash, Emily & Shryane, Therese & Wieting, Melanie & Kehoe, James & Baldé, Kees & Magalini, Federico & Zanasi, Alessandro & Bonzio, Alessandro. (2015). Countering WEEE Illegal Trade (CWIT) Summary Report, Market Assessment, Legal Analysis, Crime Analysis and Recommendations Roadmap. 10.13140/RG.2.1.4864.2328.

different ways and evidence sources to help estimate the volumes passing through electrical pathways.

Use, residence, retention and hoarding have brand new data input sources that differs to the reported EEE POM datasets previously used. This gives a higher starting point than previously, so this uplifted volume cascades its way through the POM, use and hoarding values, then into the discarded stream. The values represented here are robust in their source, and stakeholders recognise the UNU-KEY derived information behind the Global E-Waste Monitor research as leading research. Further improvements could be made to reduce the reliance upon extrapolation of sales, but when reflecting on the historic values these were still higher than the original EEE POM for 2017.

The Free-riders shift in volumes is driven by the rise of EEE POM reported through the WEEE system and supplemented by the UNU on market data for PV panels (which represents 1/3 of free-riders overall). The percentage of free-riders by category range from 0-12.5%. This modelling study assumes there has not been any material change in the rate of free-riders placing product on the market but recognises this is a low estimate given the prevalence of e-commerce and distance selling online, which is known to be very difficult to police.

The volume of WEEE treated and reported through AATF is direct from the WEEE reported by recyclers under the WEEE Regulations. This is the contributor towards producers meeting their recycling obligations, which has consistently been short of the DEFRA set targets for several years and demonstrates a steady drop in WEEE collected for recycling (see Figure 3).

The refresh of light iron provided the opportunity to seek wider involvement from Anthesis experts on data sources and use this to update the shredder in-feed data that was historically estimated by BMRA in 2015. The update here does have some variance as seen in the methodology, but the mean value presented is still a large increase. Traditionally it was believed that the light iron volumes were linked to economic factors, however there is limited correlation in the data available. Despite this, the logic behind the theory of increased metal prices driving more metal into commercial channels still seems sound. As the UK faces continued economic challenges, this theory could be well tested as a stronger draw on material prices prevails. For 2021, there was less of an impact to measure.

In the recalculation of the WEEE in residual waste, two factors are contributing to the decline; less residual waste and a considerable drop in the fraction of WEEE. It is believed that the latter is likely to be a low estimate for the UK as a whole, as when contrasted with the independent study from WRAP Cymru the composition from AHK local authority sampling across England is lower. Recycling data suggests Wales has a higher recycling rate than England. Therefore, it could be assumed that WEEE in residual would be lower in Wales than England; whereas data from Figure 11 shows the opposite,the average WEEE in residual waste for England is lower than that for Wales. This suggests the England sample needs to be greater to have better representation across *the whole* of England, Scotland and Northern Ireland and this could be achieved through more frequent local authority residual waste sampling.

The reassessment of theft of W/EEE broadly follows the pattern of the previous study with the exception of results for Display. Although we have widened the range of per product weights, the overall outcome has given a large increase for this category compared to nominal increases (driven by EEE POM) in the other categories. The analysis here again could be linked to economic drivers encouraging more products to fall out the system but could warrant further investigation given the change and the dynamic physical characteristics of displays (moving away from CRT, larger screens at lower prices, and the theory from stakeholders that suggests behavioural factors displacing and hoarding of TVs is reaching capacity in the home).

The role of IT Asset managed electronics suggests we 35houldd be seeing more products being processed through this pathway, based on manufacturer feedback, independent research and economic drivers. The move to work from home is well known to have boosted consumption of IT equipment so the uplift is expected here. Although the unclear distinction between used-EEE and waste-EEE does make this a difficult classification, reuse is a positive outcome for discarded products, so these activities are keeping some devices in use for longer. Driving more into this channel and away from waste would be a positive change.

The final pathway of illegal exports takes new research from UNITAR and gives the UK a share of the problem. The big increase here is the large-scale problem profiled by the research across Europe, and as a result of the UK high consumption rates, gives the UK a large (15%) share of the result. Any research in this area is likely to have many assumptions and difficult to measure actual activity because it is below the radar and goes undocumented. With commentary indicating poor policing there seems to be little improvements here and this is a universal problem. In our opinion the common theme of economic drivers is a factor causing this pathway to increase.

Part 2; Supplementary insights

The second part of this project builds on the refreshed baseline calculations made across some of the priority WEEE flows assessed in Part 1. The focus was to better understand the magnitude of used and waste electricals that have become held up in the system, and how those waste streams arising across the UK differ regionally. By drilling deeper and understanding what the products are and where they are delayed in their journey to reuse or recycling, the outputs look to better inform future project work including topics like education, awareness and infrastructure.

Continuing to look forwards, this study has also sought industry feedback on future product trends as an indicator, as to what products might be more popular now and in the next 5 years. This can then be used as an indicator to future challenges and opportunities for better end of life or re-use management for these types of products. The qualitative analysis is derived from a series of retail and manufacturer interviews and supplemented by other general retail market trend data. This is a high-level assessment but has provided some basis to consider the impact on consumption and disposal behaviours and trends of the future.

Interrogating sales of electricals

Previous material composition analysis available on electricals and product sales is most commonly aligned to The Waste Electric and Electronic Equipment (WEEE) Regulations 2013 (as amended) and the equivalents transposed into national laws across the EU under the WEEE Directive 2012/19/EU. This harmonised reporting published by Eurostat[43] gives a representative indicator to the types and amounts of electrical being bought by 14 categories. However, it lacks the granularity needed for product specific analysis and consumer trends and fashions needed for this study.

[43]https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-_electrical_and_electronic_equipment

For this study to advance the knowledge of EEE sales, it builds upon the previous research[44] that adopts the UNU-KEYS classification. Anthesis and Small World Consulting have developed a UK specific model that maps stocks and flows of W/EEE from the existing Waste over Time model to give better identification of product types and volumes (see 'Deeper Dive' analysis for model authors and origins). Led by Small World Consulting, analysis in this section of the research project investigated POM activity which we have considered to be equivalent to sales of electricals in the UK.

The 54 UNU-KEYS have been extrapolated up to 2021 from statutory reporting in 2019 and offers greater insight beyond the 14 recognised in the previous Material Focus study. The largest volume categories by quantity (Figure 8) and weight (Figure 9) have been determined, with the latter broadly aligning to the UK government published data by UK 14 EEE categories (by weight). Interpretation of product sales reporting and classifications is based upon statutory reporting from businesses and then which (or how much) of those categories meets the definition of EEE. These are considered to be the best available for the purposes of this analysis because it has involved multiple industry experts in compiling and classifying the raw data which we build upon for this study. The methodology gives us a sound basis for analysis of the product and quantity data. For further detail on the methodology developed here, see Appendix III.

Further opportunities for improved accuracy could come from more recent actual datasets (less extrapolation) and deeper dive into CN/HS code updates that periodically happen to more accurately recognise new technologies and product type classification. This would build on the work of research authors and to allow for consistency and incorporate previous research learnings to fully maximise the UK specific insights.

[44] Van Straalen, V.M, Roskam, A.J., Baldé, C.P. (2016). "Waste over Time" [computer software]. The Hague: Statistics Netherlands (CBS). Information retrieved 10 August 2017. Available at: http://github.com/Statistics-Netherlands/ewaste.

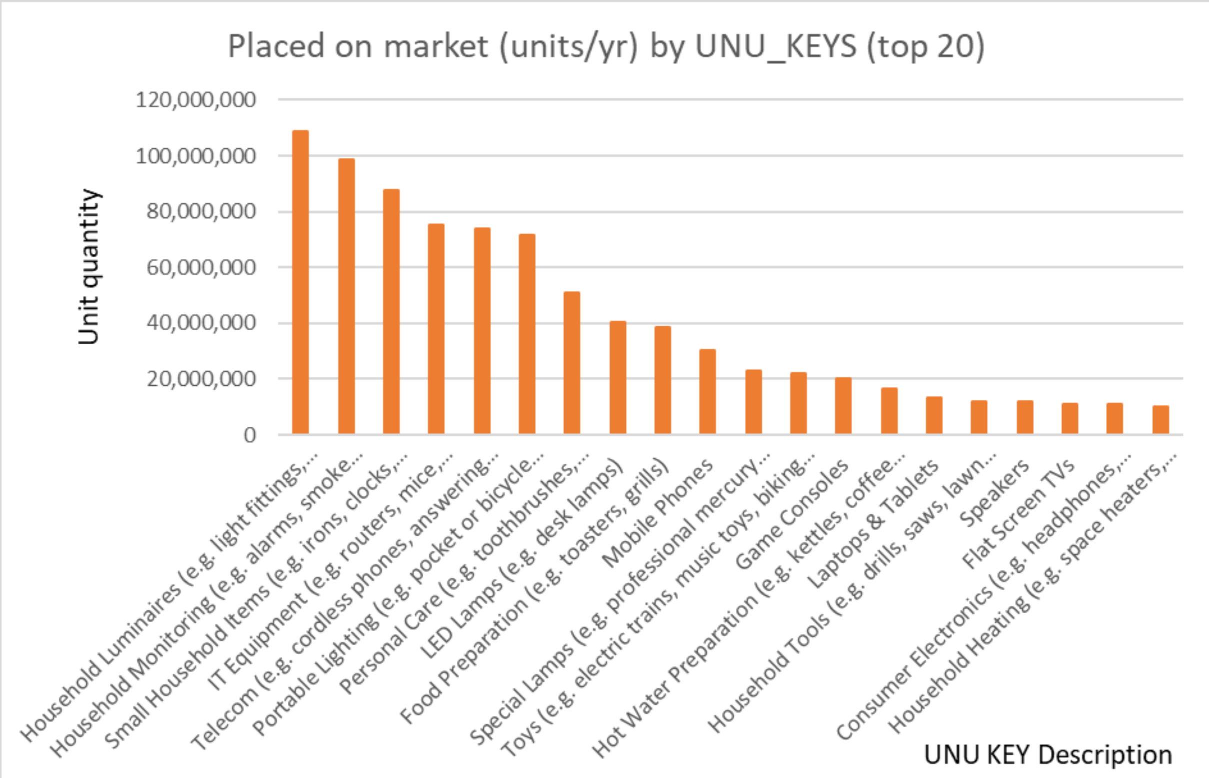


Figure 8 Placed on market (unit/year) by UNU-Keys, showing the largest volume categories by quantity.

The new insights on product quantities show that there is a greater quantity of smaller (by weight) electricals sold each year, which could be more consumable or simply have a shorter lifespan than that of the larger and heavier items that typically feature in EEE data. The result is that they are more frequently bought and/or replaced by consumers.

Interviews with retailers echoed some of the top selling product trends in product categories like; small household items, food preparation, and mobile phones, which were mentioned as popular items bought frequently. These and other lower price items sell in greater volumes even though they represent a small material weight representation across the EEE product portfolio.

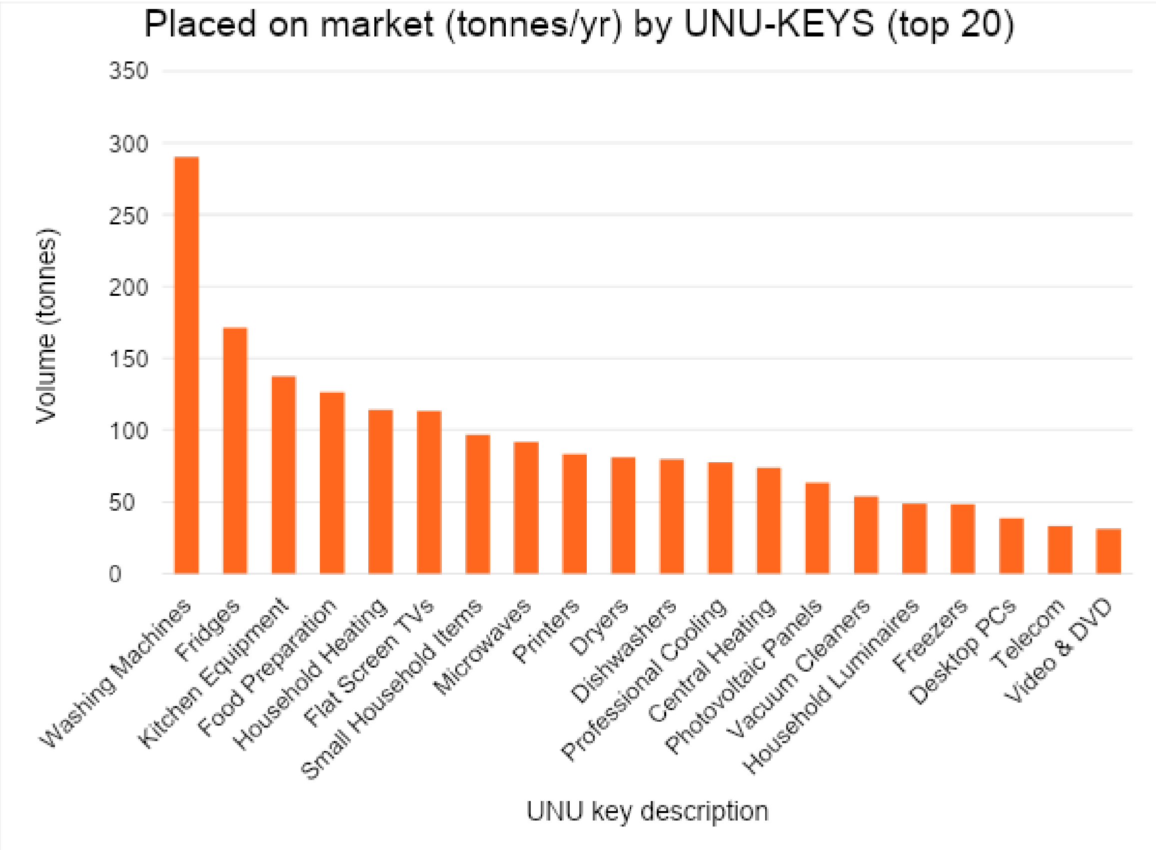


Figure 9 Placed on market (unit/year) by UNU-Keys, showing the largest volume categories by weight.

The weight-based assessment of sales is similar to that of the EEE reported as POM in terms of the availability of robust data, but with the added benefit of offering more product type granularity. Alignment of retailer feedback that supports the prevalence of some top selling categories here included recent (~2021) popularity of products used in the home and particularly kitchen and the commonly occurring heavy items like washing machines and the increasing weight per unit of new fridges. The presence of household luminaires as a category within the top 20 by weight does pose questions on the classification system whether this is what general consumers and possibly some businesses making statutory reports, would consider to be the 'bulb' or a 'lamp surrounding the bulb', or even both.

Disposal trends of electricals

To contrast the sales of electricals (POM data) this study reflects upon the disposal of electricals. This study gives particular attention to waste arising in; electricals discarded via residual waste stream (see Part 1 – Residual Waste) and waste electricals sent for recycling through official reported channels (WEEE collected and received by AATF's. See Part 1 – Via AATF (WEEE recycling). From these 2 disposal routes we then look to understand more about what products and where these may be arising across the UK. These research findings are split into two parts:

1) Stocks and flows – flow into discarded after first use derived from the UNU-KEY based Waste over Time model measuring the volume (weight) of waste flows, providing new insights into product quantities and types not seen before.

2) UK regional electrical waste arisings – analysis of local authority data to determine the amount of WEEE in residual waste by region (total weight) and the amount of WEEE collected for recycling by region (total weight and weight per household).

Stocks and Flows – discarded

Based on the Waste over Time modelling by SW Consulting for the 2021 flows into discarded after first use, predictably this study finds the same types of products as that POM. The model does offer a calculation to the quantity of these products flowing into the discarded pathway suggesting how much W/EEE could be diverted into correct recycling or reuse channels. Figure 10 illustrates the volumes (by weight) and the product types determined from the model for 2021. The total volume flow into discarded after first use is 1,873kt across all electricals.

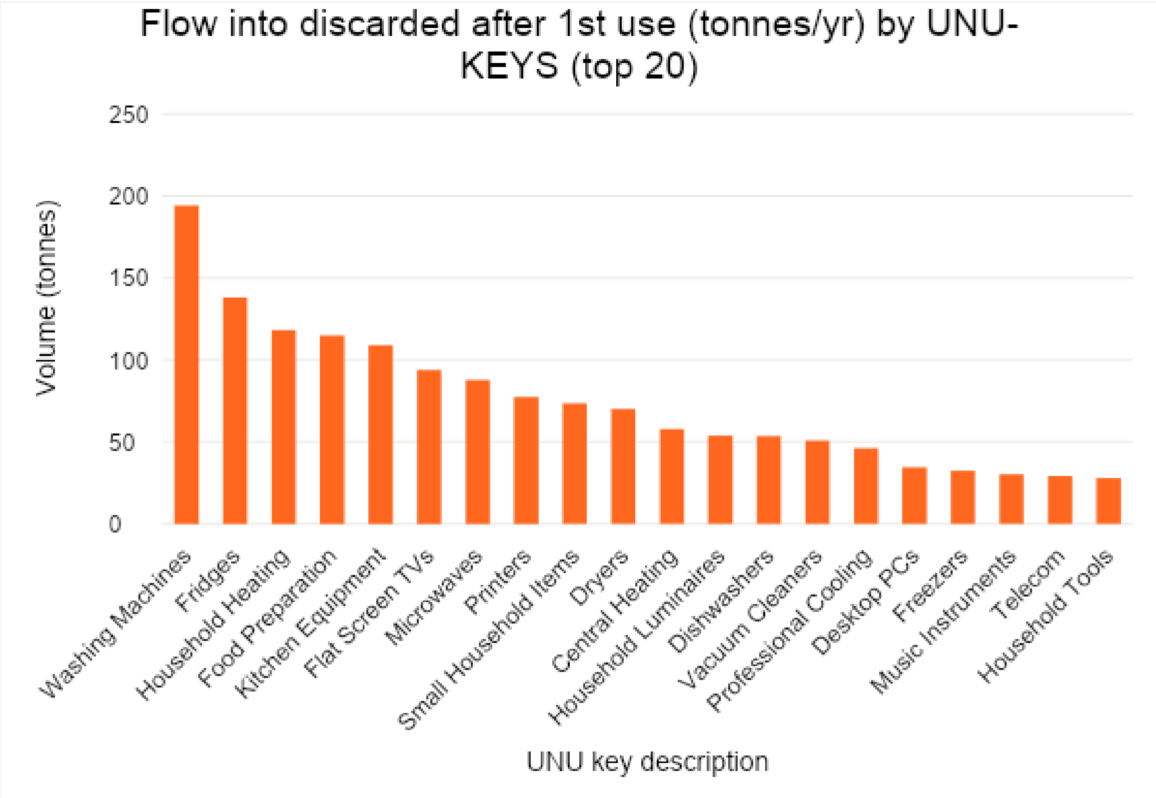


Figure 10 Flow discarded (tonnes) after first use, split by product.

The volumes presented here are modelled through recognised flows mapping but utilising UK specific data alongside UNU-KEY product classification. The 1,873kt is the total potential volume that could be diverted into correct recycling or reuse pathways. When contrasted with the AATF data (see Part 1 – via AATF) it can be seen that the proportion of WEEE that is being handled through accredited WEEE treatment pathways is around 25% of all that is discarded. This leaves the remainder to be handled by other pathways and operations which are not accounted for through official channels, potentially lost from the WEEE system.

UK regional waste arising (residual and recycling)

This section cross references various national datasets from 2021-22 FY to interrogate WEEE arising in general waste (residual) and WEEE collected through official recycling pathways (via local authority managed waste systems). The insights here offer greater visibility on the volumes per region and averages per household to understand the profile and variances across the UK.

WEEE in residual waste

As outlined earlier residual waste, often referred to as “black bag waste”, is waste that has not been separated and cannot be recycled or reused. Whilst WEEE should be collected separately so that it can be handled and treated appropriately, a proportion of WEEE still ends up in residual waste, meaning that these items are not recycled and that their value is lost. Previous studies commissioned by Material Focus look into why this happens, and here we look to quantify these volumes.

Analysis found that there was between 97.6k to 107k tonnes of WEEE in household residual waste in 2021, taking the mean value this is 103kt or 0.67% of residual waste volume. A high-level approach (composition data applied to the residual tonnage) was also determined along with a detailed bottom-up approach applying the compositional analysis to the raw data and scaling this up for the UK, hence the range. Both the high end and low-end estimates of WEEE in residual have been applied to the number of households per region, so a range is also given for the regional analysis. Due to a different data source for the Welsh compositional data, Wales does not have a range like the other regions.

The calculations for the amount of WEEE in residual waste per region was determined using UK residual waste tonnages, household numbers per region and compositional sampling data. A full overview of the methodology used to determine the amount of WEEE found in residual waste can be found earlier in the report. Once the total tonnage of WEEE found in residual waste was determined, the data was analysed further to determine regional variations as seen in Figure 11. The WEEE tonnage found in household residual waste has been calculated for each region based on waste compositional sampling in 68 local authority areas and household numbers in each region, so directly relates to household numbers.

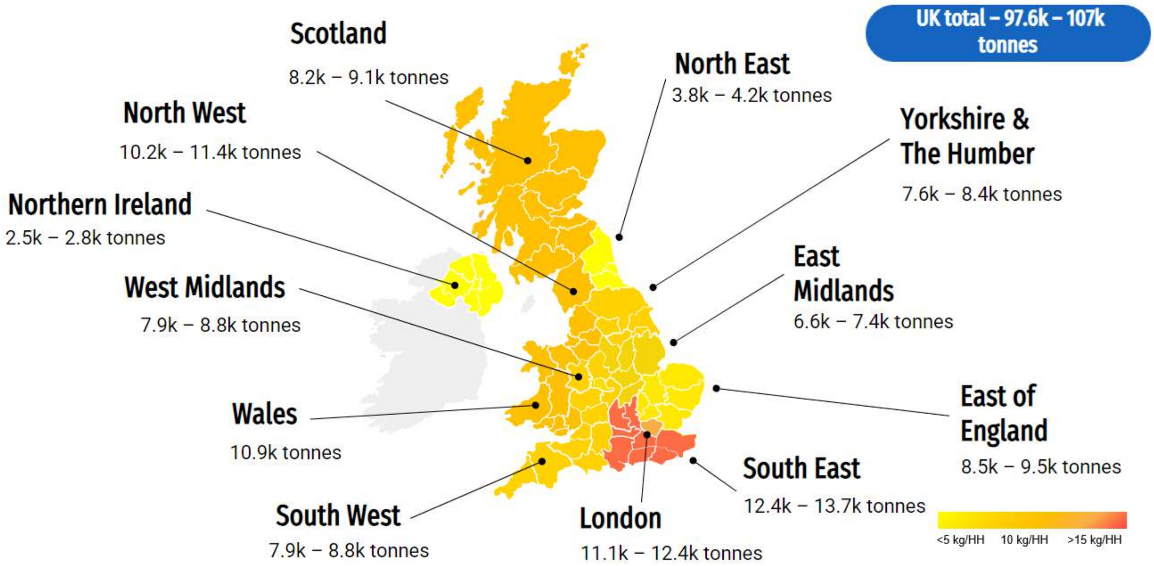


Figure 11 Total amount (tonnes) of WEEE found in household residual waste by region (2021) (Anthesis, 2023. This infographic has been created using publicly available information and data, and graphics from Slidesgo and Freepik).

Residual tonnage data was obtained from SEPA (Scotland), Waste Data Flow (England), DAERA (Northern Ireland) and Stats Wales (Wales). Household data was obtained from ONS (England and Wales), NRS Scotland (Scotland) and NISRA (Northern Ireland). The % WEEE in residual waste was determined from waste compositional data derived from sampling and obtained for this project (England, Scotland and Northern Ireland) and WRAP Cymru (due to a different data source for the Welsh compositional data, Wales does not have a range like the other regions). The WEEE tonnage found in household residual waste has been uplifted for each region based on the compositional sampling data and household numbers in each region, so directly relates to household numbers.

WEEE collected for recycling

Household waste electricals are collected for recycling by local authorities in a variety of ways or services available for local households and sometimes businesses. A large proportion of the electricals collected for recycling is taken to recycling centres (HWRCs). This analysis only considers household WEEE that is managed through Local Authority waste management services. Data is available on the quantity of household WEEE collected for recycling from:

- England – WDF[45], which is the web-based system for municipal waste data reporting by UK local authorities to the government.
- Scotland – data on the generation and management of household waste is available via SEPA's Scottish Household Waste Discover Data Application[46].
- Wales – data is available from WDF [47].
- Northern Ireland – local authority collected municipal waste management statistics are

[45] https://www.wastedataflow.org/home.aspx

[46] https://informatics.sepa.org.uk/HouseholdWaste/

[47] https://www.wastedataflow.org/home.aspx

available from DAERA[48].

The aggregated data for the UK shows that 263kt tonnes of WEEE is collected from households across the UK for recycling. This equates to on average 9.36kg per household (Figure 12). Data on the number of households is available from ONS (England and Wales), NRS Scotland (Scotland) and NISRA (Northern Ireland).

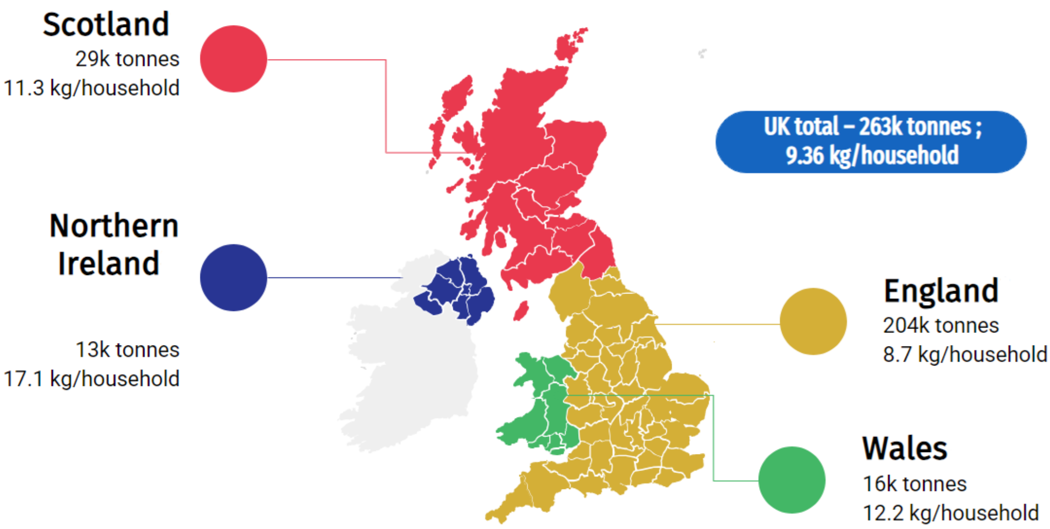


Figure 12 Household WEEE collected in the UK by local authorities for recycling by country (2021) (Anthesis, 2023. This infographic has been created using publicly available information and data, and graphics from Slidesgo and Freepik).

Tonnage data has been obtained from SEPA (Scotland), Waste Data Flow (England and Wales) and DAERA (Northern Ireland) and household data has been obtained from ONS (England and Wales), NRS Scotland (Scotland) and NISRA (Northern Ireland).

The data obtained for England was analysed to determine the tonnage of WEEE collected for recycling by region (London, West Midlands, East Midlands, East of England, North East, Yorkshire and The Humber, South East, South West, North West). This then allowed for a review of the average amount (weight in kilograms) of WEEE collected for recycling by local authorities per household by region in England (Figure 13). The amount of WEEE collected for recycling per household was also determined for Scotland, Wales and Northern Ireland (Figure 13). The data from Northern Ireland has been interrogated because of the outlier results from the calculations. This study could not identify any reason as to why the apparent WEEE collected in this region per household is disproportionately higher than the rest of the UK in terms of the services available to households being materially different, or the Local Authority reported data being interpreted differently.

[48] https://www.daera-ni.gov.uk/publications/northern-ireland-local-authority-collected-municipal-waste-management-statistics-time-series-data

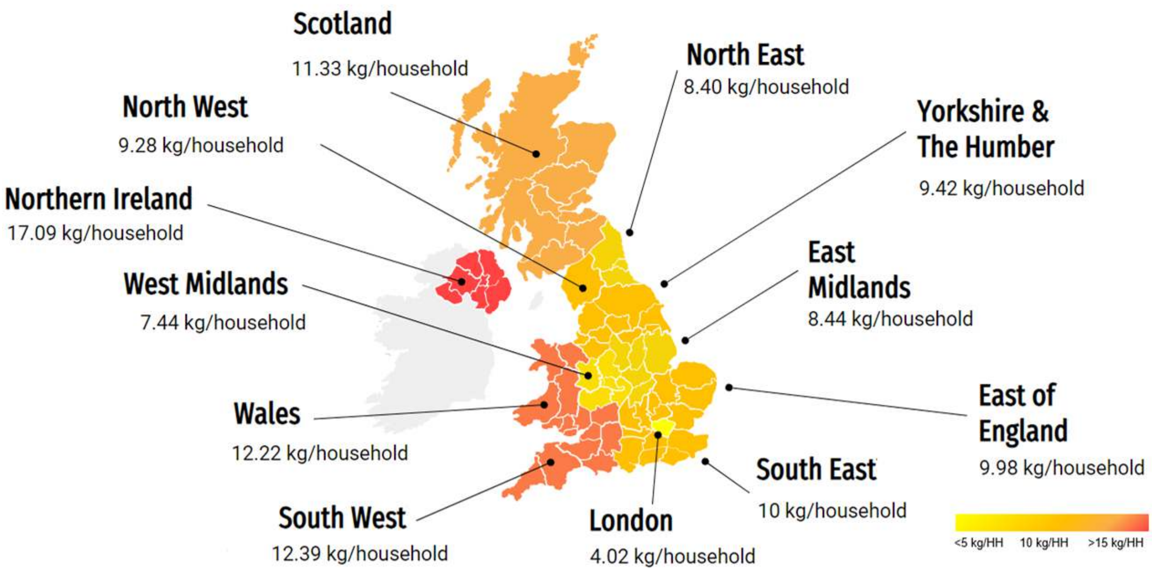


Figure 13 Average weight (kg) of WEEE collected for recycling by local authorities per household by region (2021) (Anthesis, 2023. This infographic has been created using publicly available information and data, and graphics from [Slidesgo] and [Freepik]).

Tonnage data has been obtained from SEPA (Scotland), Waste Data Flow (England and Wales) and DAERA (Northern Ireland) and household data has been obtained from ONS (England and Wales), NRS Scotland (Scotland) and NISRA (Northern Ireland).

Deeper dive into hoarding

The new analysis performed by SW Consulting for this report covered around 96% of the Eurostat-derived EEE POM in 2021, estimated from near-term forecasts in the Waste Over Time (WOT) model v1.2[49,50]. This included data for all 54 product categories referred to as UNU-KEYS. UNU-KEYS were developed by the United Nations University by linking over 600 product types that could be considered WEEE allowing harmonisation of different data sources. By incorporating other UNU product classifications determined to be electricals it provides greater product type granularity. UNU-KEYS are constructed such that product groups share comparable average weights, material compositions, end-of-life characteristics and lifespan distributions developed by Wang, F.; et al. 2012 and applied in EU research projects[51].

Approximately 4% of the WOT electricals POM are not included in the new analysis were discarded from the modelling on the basis of the granular UK product assessment performed by REPIC and Lancaster University in 2018[52], which considered nearly 800 Common Nomenclature (CN) product

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[49] Van Straalen, V.M, Roskam, A.J., Baldé, C.P. (2016). “Waste over Time” [computer software]. The Hague: Statistics Netherlands (CBS). Information retrieved 10 August 2017. Available at: http://github.com/Statistics-Netherlands/ewaste.

[50] Stowell, A.F., Yumashev, D. et al. (2018). “Setting robust and realistic PCS targets for WEEE to support the transition to a Circular Economy – an Industry White Paper”. Available at: http://dynamicweeemodel.co.uk.

[51] https://ec.europa.eu/environment/pdf/waste/weee/Final_Report_Art7_publication.pdf

[52] Stowell, A.F., Yumashev, D. et al. (2018). “Setting robust and realistic PCS targets for WEEE to support the transition to a Circular Economy – an Industry White Paper”.

types underpinning the WOT data for POM[2].

The previous assessment for Material Focus only considered 34 UNU keys but estimated this covered around 73% of the total POM from WOT[53]. The products had been selected on the basis that at least some metadata on times in use and in hoarding, stocks in use and in hoarding, and product fates could be found in published literature.

In this updated assessment, no new metadata for the times, stocks and fates has been sought. Instead, the focus has been on:

- Extrapolating the metadata for the times, stocks and fates from the 34 UNU keys to the remaining 54 UNU keys using reasonable assumptions.
- Filtering the WOT POM according to the earlier CN-level UK product assessment.
- Separating second-hand EEE flows from WEEE flows and quantifying the associated second-hand stocks and end of life WEEE.
- Identifying top 10 products (as described by UNU keys) according to units and tonnages in hoarding, units and tonnages flowing into hoarding, and units and tonnages in EEE POM.
- Comparing the resulting estimates for UK's EEE POM and WEEE collected with the relevant Environmental Agency data.

The updated assessment uses the following datasets:

- EEE POM from the WOT model for 54 UNU keys.
- Mapping protocol between UNU keys and UK14 categories developed by REPIC and Lancaster University.
- Metadata for times in use and in hoarding, stocks in use and in hoarding, and product fates from the 2020 Material Focus Challenges and Opportunities report[54] (five separate datasets).
- UK population and number of households provided by the ONS.
- Environmental Agency data for EEE POM and WEEE collected reported by a PCS.

Using analytical platform software for data analysis, results were derived to show the flow of electricals from the point they are POM, the product time in use and residence/retention and hoarding, before flowing into a second life pathway or waste disposal stage. At each level volumes and quantities are assessed. The interconnected flows and stocks simulated by the updated model are illustrated in Figure 2.

Comparison with the government published data from Environment Agency

Compared with Environment Agency data for POM, the POM estimate used in the new analysis is around 14% higher (~2,200kt/yr vs ~1900kt/yr). The result of utilising this new approach means the apparent difference between the Material Focus study published in 2020 (based on 2017 data) and the update carried out in this project (based on 2021 baseline data) has lead to a major leap in the

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[53]Sayers, M. et al. (2020). "Electrical Waste: Challenges and Opportunities. An investigation into Waste Electrical and Electronic Equipment (WEEE) flows in the UK". Available at: https://www.materialfocus.org.uk/report-and-research/electrical-waste-challenges-opportunities-2/.

[54]Sayers, M. et al. (2020). "Electrical Waste: Challenges and Opportunities. An investigation into Waste Electrical and Electronic Equipment (WEEE) flows in the UK". Available at: https://www.materialfocus.org.uk/report-and-research/electrical-waste-challenges-opportunities-2/.

volumes reported as sold, use and retention and hoarded. To make the comparison more reflective in comparison between the 2 studies we have applied the new methodology to the historic data sets in Table 8. A full breakdown of comparative figures can be seen in Appendix IV.

Table 8 Comparison between data published by the Environment Agency and the POM volumes estimated use for this project

EA comparison	2021	2020	2019	2018	2017
This model POM (ton/yr)	2,194,858	2,155,041	2,117,340	2,081,022	2,045,861
EA reported POM (ton/yr)	1,922,551	1,824,481	1,720,880	1,548,529	1,614,604
This model WEEE collected (ton/yr)	1,085,510	1,066,673	1,041,110	1,016,984	994,706
EA WEEE collected (ton/yr)	498,331	466,420	505,445	501,262	534,335
Flows					
POM (new) (units/yr)	899,446,679	883,724,724	874,643,961	870,601,656	869,863,122
POM (new) (ton/yr)	2,194,858	2,155,041	2,117,340	2,081,022	2,045,861
Flow discarded after first use (ton/yr)	1,872,776	1,838,820	1,797,437	1,765,530	1,730,249
Flow into hoarding (ton/yr)	214,039	210,037	206,194	205,676	203,499
Flow discarded after hoarding (ton/yr)	207,198	203,848	200,755	200,931	199,403
Rate of change for stock in hoarding (ton/yr)	6,841	6,189	5,440	4,745	4,096
Total WEEE (ton/yr)	1,862,815	1,829,362	1,789,488	1,758,986	1,725,182
Stocks					
Stock in first use UK (units)	6,584,985,093	6,579,909,616	6,561,593,970	6,521,121,708	6,473,583,740
Stock in first use UK (tonnes)	17,804,593	17,568,772	17,246,489	16,794,618	16,472,321

The difference in the datasets is most likely due to the following:

- Discrepancies in the product scope interpretations (model).
- Differences in the product weight estimates (model).
- Free-riders not accounted for (Environment Agency data).
- A minority volume but long tail of producers who fall below the threshold (Environment Agency data).
- Producer misreporting (however net effect may be nullified in Environment Agency data).

The modelled WEEE collected on the basis of including the WEEE fates “Recycled”, “Take-back scheme” and “Other” (likely to include scrap metal) is roughly two times higher than the WEEE collected totals reported by the Environment Agency (~1000kt/yr VS ~500kt/yr). The shortfall is broadly consistent with existing estimates of the WEEE treated as scrap metal (mostly LDA) and through other unofficial routes, all of which are not captured in Environment Agency published data.

Material Compositions

To better understand the consequences of electricals lost after use or stuck in the home, this study applies the earlier findings that modelled the volume of electricals (quantities and weights) and applies recognised average material characteristics to see what this means for the raw materials used to manufacture products. The aim is to highlight the opportunity to keep more of these materials which make the products to be kept in use for longer or recovered into more circular systems like recycling or reuse.

Using the data obtained for the use, retention, residence, hoarding calculations, the quantity of different material types hoarded in UK households was determined through this new modelling calculation. The number of units of commonly hoarded items was applied to the key materials each product contains. Material weights per product were available from earlier research commissioned by Material Focus[55].

This analysis found that there are large quantities of valuable materials found in everyday items that are hoarded by UK households.

- There are ~26.5 million hoarded laptops, mobile phones and tablets in UK households. This means there is approximately 810 tonnes of steel, 662 tonnes of aluminium and 1020 tonnes of lithium batteries in UK households as a result of these products being hoarded.

- There are ~6.4 million hoarded personal care items in the UK. In electric shavers, hair straighteners, hair dryers and electric toothbrushes this equates to approximately 56 tonnes of steel, 138 tonnes of lithium batteries and 93 tonnes of aluminium hoarded in UK households from these items. In addition, 814 tonnes of “plugs and wires” belonging to personal care items are hoarded.

- There are ~4.3 million hoarded food preparation items in the UK. In toasters and blenders this equates to approximately 923 tonnes steel and 509 tonnes of plugs and wires not in use in UK households as a result of these items being hoarded.

Hoarded products represent items that are not in use, but which are still in the household. As illustrated above, these products contain a range of different but valuable materials. In the case of

[55]Hidden treasures research by Eunomia for Material Focus, unpublished.

plugs and wires, which make up a high proportion of the weight of personal care products, these items contain a significant amount of copper. Nearly 70% of worldwide copper produced is used for electrical/conductivity applications and communications. Copper can be recycled without any significant loss of performance[56] with recycled copper having lower CO2 emissions than virgin copper, due to a lower energy requirement than primary production[57]. It is therefore of benefit for the copper in plugs and wires that are no longer in use, or required, to get back into the recycling system and be recycled for use in new products, reducing demand for virgin copper. While this is just one example, it is applicable to many of the other materials contained within hoarded products.

In addition to the materials outlined above, which occur in electronics in larger quantities, a range of other valuable non-renewable resources including gold, silver and platinum are contained in electronics in smaller quantities[58].

Carbon (CO2e) Savings

Carbon dioxide equivalent or CO2e means the number of metric tons of a greenhouse gas with the same global warming potential (GWP) as one metric ton of carbon dioxide (CO2) over 100 years. It is the standard way of allowing comparison between emissions of different types of greenhouse gas (such as methane)[59]. Most of the global warming impact of electricals occurs before they are used for the first time. That's because, for many products, extracting raw materials and the manufacturing process are very carbon intensive[60]. Some products (e.g., washing machines, tumble dryers) will also have a high in-use impact due to their high electricity consumption.

Carbon measurements are becoming a more prominent way of measuring impact of products. This study selected some example electricals that are commonly lost or unused and held within the lifespan, to understand a CO2e metric for electricals. Using data obtained for the use, retention, residence, hoarding calculations and applying this to the per product embedded CO2e (tonnes) from commonly hoarded items in UK homes the CO2e of commonly hoarded product types has been determined (Table 9). This high-level analysis shows the scale of CO2e footprints lost by products that are stuck in homes and businesses, which could be better handled if processed through reuse and recycling channels. The CO2e footprint draws attention to items that are well recognised and commonly in the home but through consumer behaviour are not managed well.

[56] https://copperalliance.org/resource/copper-recycling/#:~:text=Copper%20is%20100%25%20Recyclable,they%20can%20be%20used%20interchangeably.

[57] https://copperalliance.org/resource/copper-recycling/#:~:text=Copper%20is%20100%25%20Recyclable,they%20can%20be%20used%20interchangeably.

[58] https://www.nhm.ac.uk/discover/what-is-ewaste-and-what-can-we-do-about-it.html#:~:text=When%20broken%20or%20unwanted%20electronics,%2C%20platinum%2C%20aluminium%20and%20cobalt.

[59] https://therestartproject.org/consumption/hidden-impact-devices/

[60] https://therestartproject.org/consumption/hidden-impact-devices/

Table 9 Embedded CO2e (tonnes) of commonly hoarded items in UK homes

Product category	CO2e (tonnes) of commonly hoarded items in UK homes[61]
Laptops and tablets	1,426,433
Mobile phones	1,066,478
Food preparation*	126,683
Personal care**	65,953
*toaster and blender **electric shaver, hair straightener, hair dryer and electric toothbrush	

Future Trends

The final research insights for this study, look to future challenges and opportunities that businesses and consumers may face regarding consumption of electricals; including consumer spending economic analysis from published research, and feedback gathered from interviews with 10 stakeholders across the WEEE system representing; retailers, manufacturers, trade associations and WEEE compliance schemes. The purpose is to understand some of the main drivers and consequences of changing behaviours towards electricals being bought.

Retail spending and sales trends

ONS data suggests that over 6 in 10 adults (67%) in Great Britain are spending less on non-essentials in response to the increased cost of living[62]. In addition, 53% of those surveyed are shopping around more (Table 10).

[61] https://therestartproject.org/consumption/hidden-impact-devices/

[62] Results from ONS's Opinion and Lifestyle Survey, for the period 28 June to 9 July 2023 https://www.ons.gov.uk/economy/inflationandpriceindices/articles/costoflivinginsights/spending

Table 10 Cost of living insights – spending (ONS, 2023)

Question	Which of these, if any, are you doing because of the increases in the cost of living?
Spending less on non-essentials	67%
Shopping around more	53%
Using less fuel such as gas or electricity in my home	46%
Spending less on food shopping and essentials	43%
Cutting back on non-essential journeys in my vehicle	29%
Using my savings	28%
Making energy efficiency improvements to my home	21%
Using credit more than usual, for example, credit cards, loans or overdrafts	16%
None of these	11%
Doing other things	8%
Using support from charities, including food banks	3%

Figure 14 gives an overview of retail sales volumes from June 2019 to June 2023. It is difficult to determine an overall trend in sales volumes, due to the impact of the COVID-19 pandemic and the current cost of living crisis, with peaks and troughs in sales being impacted by both COVID and the cost of living. It is therefore challenging to accurately predict future trends based on the trends of the previous 4-5 years due to the influence of these exceptional factors.

Figure 14 Retail sales volumes in Great Britain (ONS, 2023)

The electronics market

As of 31 March 2023, the UK business-to-consumer electricals market was worth £30 billion, a decrease of 2.9% since April 2022[63]. Despite this, small domestic appliances and mobiles continued

[63] https://www.ao-world.com/wp-content/uploads/2023/07/31520-AO-World-AR2023-webready-FINAL.pdf

to see growth[64]. While it is challenging to determine future trends based on the trends of the past 4-5 years, data published in the annual/financial reports of three large retailers suggests that electronics sales are falling to pre-pandemic levels following the COVID boom in home technology.

Data from John Lewis suggests that the split of technology sales (total category mix: technology, fashion and home) fell from 45% in 2020/21 to 36% in 2022/23, which is closer to the last full year pre-pandemic 2019/20 level of 35%[65]. In addition, AO's 2023 Annual Report recognises that there has been a slight downturn in the last year for electrical sales, despite the electricals market growing 19% over the last 10 years[66]. In addition to AO and John Lewis, Curry's reported that like-for-like sales fell 7% in the year to 29th April[67]. To help combat this, some retailers have rationalised stock and SKUs to focus on profitable lines of business. The move over the past 5-10 years of online shopping, especially for electronics, was also highlighted by stakeholders as continuing to grow. The increasing preference of consumers buying online has the potential to give them access to a wider variety of products and quicker route to market than consumers visiting retail stores who stock product on the high street.

The cost-of-living crisis is having an impact (positive and negative) on specific products and product categories as well as the electronics market as a whole (Table 11). For the general electronics market it is possible that the decrease in sales will continue as the cost of living continues to be a key consideration for consumers, or at least start to plateau when the impact of cost of living starts to ease, potentially in 2024 if inflation falls[68].

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[64] https://www.ao-world.com/wp-content/uploads/2023/07/31520-AO-World-AR2023-webready-FINAL.pdf

[65] https://www.johnlewispartnership.co.uk/content/dam/cws/pdfs/Juniper/ARA2023/jlp-plc-annual-report-and-accounts-2023.pdf

[66] https://www.ao-world.com/wp-content/uploads/2023/07/31520-AO-World-AR2023-webready-FINAL.pdf

[67] https://www.ft.com/content/4e47369b-fb6e-4716-a273-9d72a14588e1

[68] https://www.bankofengland.co.uk/explainers/will-inflation-in-the-uk-keep-rising#:~:text=Higher%20interest%20rates%20will%20also,would%20be%20only%20rising%20gradually.

Table 11 Impact of cost of living on sales of certain products and product categories

Impact factor	Description
Increase in energy saving technology	As highlighted in Table 10, 21% of people are making energy efficiency improvements to their homes. This is also being seen in the types of products people are buying, with desktop research suggesting that there has been an increase in energy saving technology over the last year or so. One retailer reportedly saw a 150% rise in air fryers sales and a 50% year on year rise in microwave sales[69]. In addition to energy saving cooking products, the same retailer saw a 340% and 188% year on year rise in heated blankets and dehumidifiers respectively[70].
Decrease in discretionary purchases and increase in some money saving food preparation and beauty appliances	There is an apparent decrease in overall spend as consumers forgo some discretionary purchases to help manage budgets. Curry's reported that sales of smart speakers had "fallen off a cliff"[71], whereas people are spending on gaming, coffee machines and electronic haircare appliances to try and save money by doing more at home[72]. The reported fall in smart speaker sales at Curry's (which is reported to have gone against industry analysts expected boom in smart speaker sales) is potentially due to consumers being more careful with their money and possibly "trading down to buy lower value items"[73]. However, in response to the reported decrease, Amazon said that "Curry's is responsible "for a very small number of our high street product sales. Our customers continue to love Alexa"[74]. These findings are consistent with feedback from stakeholders interviewed as part of this project, who highlighted that the cost of living is having an impact on what people are buying and what they want to spend their money on.
Move towards "own brand" products	Stakeholders highlighted that consumers are potentially moving away from premium or branded products and tending to still buy the items but choosing own brand or less expensive versions of the same products. Consumers are still buying items; they are just moving toward different types of products and/or different price bands. It is challenging to fully assess this trend in terms of quantity and weights.

[69] https://www.housebeautiful.com/uk/lifestyle/shopping/a42729526/home-tech-trends/#r3z-addoor

While the cost-of-living is impacting on what consumers are currently purchasing, stakeholders interviewed as part of the project also provided valuable insights into more general trends and future predictions.

From interviews carried out, there was no clear consensus on whether consumers are buying electricals to replace old or broken items or to have a second and newer version of the same product in the home already. If new innovative products come to market, consumers are still likely to buy these potentially even if they have an older, less "high tech" version of the same item that still works. This feedback suggests there is a drive for some consumers to have the latest and greatest electricals, rather than on a faulty-replacement basis. The entertainment category (gaming) is likely to follow this trend, with sales increasing following new product releases and consumers either keeping older versions as they become "retro" items or selling them on and taking advantage of the large used resale market for this desirable equipment.

Stakeholders interviewed as part of the project indicated that the increase in "smart" versions of some products are causing sales of more traditional products to rapidly decrease. This can be seen with audio products where smart speakers are replacing radio sales, and televisions where smart TVs are making set top boxes obsolete for many households. Feedback suggests that sales of wired headphones are starting to decrease to reflect an increase in sales of wireless versions, particularly as these increase in performance and decrease in price. Some stakeholder felt that wireless headphones and earbuds could be one of the main product types where consumers look to buy cheaper non-branded versions over premium brands due to the range of retailer outlet types they can be found in and the number of different versions (and price brackets) available on the market. In the longer-term, retail stakeholders interviewed as part of the project expect an increase for "tech for the home", wearable tech and visual tech as new products with increased functionality become available.

In terms of the small retail sector (e.g., convenience stores, multiples, independents, forecourts), stakeholder engagement stated that the main electrical categories sold are E-Cigs, sundries and sport and leisure. Common items include batteries and some electrical products, such as air fresheners and phone chargers. The single use vape market has grown significantly in recent years, with these items now making up a significant proportion of small retailers' electronics sales. Small retailers surveyed as part of the project highlighted that sales are in line with expectations given market trends and consumer habits, with the biggest influences impacting the types of products consumers are buying from the small retail/convenience sector being price, demographics of the store and purpose of the visit ("customer mission").

While there is, to some degree, robust information publicly available on product specific trends, the findings and comments received on smart speaker sales shows a potential inconsistency across the retail sector and between traditional high street retailers and online only retailers. Some retailers suggest speaker sales are falling whilst others are suggesting they are improving. This type of mixed

[70] https://www.housebeautiful.com/uk/lifestyle/shopping/a42729526/home-tech-trends/#r3z-addoor

[71] https://www.bbc.co.uk/news/66120000

[72] https://www.ft.com/content/4e47369b-fb6e-4716-a273-9d72a14588e1

[73] https://www.bbc.co.uk/news/66120000

[74] https://www.ft.com/content/4e47369b-fb6e-4716-a273-9d72a14588e1

feedback from retailers makes it challenging to fully understand product trends across the market as a whole. These mixed views suggest there are differences across retail channels like online versus high street. The e-commerce market is growing in size and by product diversity. As a result, it can be difficult to sample a small number of stakeholders for a true market representation which would have traditionally been more representative and possible when speaking with the biggest retailers. There is therefore some limitation to a representation from all product groups and specialist retail channels. Further research could be warranted to look more closely at online sales to understand the product consumption and retailer landscape.

Appendix I; Light Iron WEEE flows

The light iron flow can be broken down into the following sub-flows:

- DCF mixed scrap.
- SMW and display equipment from AATFs.
- End of Life Vehicles.
- Separately collected LDA at a DCF site.
- All other sources.

The combined total of the above sub-flows gives the total light iron in-feed to a shredder. The total LDA in Light Iron was estimated to be 349kt (11% of all other sources) (Table 12).

Table 12 Light Iron flows and the amount of LDA found in Light Iron

Activity/Flow	Comment	2021 (kt)
DCF mixed scrap	Removed from total LDA in light iron	271
Small mixed WEEE and display equipment from AATFs	Removed from total LDA in light iron	78
End of Life Vehicles	Removed from total LDA in light iron	1,310
Separately collected LDA at a DCF site	Removed from total LDA in light iron	165
All other sources	Assumed to contain 11% LDA not accounted for elsewhere	3,176
Total Light iron in-feed to shredder	Estimated using England's EA WDI (2021) and Wales' NRW (2021) data	5,000
Total LDA in Light Iron	**11% of all other sources**	**349**

Each of the inputs to this calculation are explained below and tested against the robustness of the source or representation towards the calculation:

Total Light Iron In-Feed to a Shredder

Estimated range of 4,776 – 5,442kt. For simplicity of the presented result, the study has taken 5,000kt as the estimated figure for the rest of the calculations. The total Light Iron in-feed to a shredder was directly estimated using England's Environment Agency WDI (2021) and Wales' NRW (2021) data and extrapolated according to population estimates for Scotland and Northern Ireland. The methodology used to determine this first identified sites that are not transfer stations and report shredded metal output on the WDI outputs database. Following this the Anthesis team used the list of sites obtained and sum metal inputs based on metal EWC codes. This resulted in a list of metallic inputs into sites that are likely carrying out metal shredding. The total was calculated by summing the metallic inputs to all these sites.

The robustness of the In-feed calculation does rely on the following:

- WDI data needs to be accurately recorded by waste management operators, otherwise impacting on the accuracy of the results.

- Some of the tonnages may include other metals (e.g., non-ferrous) or other materials which are difficult to separate from the estimates due to the poor data quality.
- If the same materials leave and enter multiple sites before reaching their end destination and therefore double counted in the government data (where not classified as waste transfer station which have already been removed to limit this factor).

DCF Mixed Scrap

The final tonnage was estimated to be 271kt.

DCF mixed scrap was estimated using WDF data (2021) for England and Wales and extrapolated according to population estimates for Scotland and Northern Ireland.

Small mixed WEEE and display equipment from AATFs

This final tonnage was estimated to be 78.32kt.

The amount for SMW and display equipment from AATFs was calculated using Environment Agency UK statistics for household and non-household WEEE for Categories 3 and 11 from AATFs.

End of Life Vehicles

Estimated tonnage of 1,310kt.

The figure for end-of-life vehicles was taken from a report that quoted the reported 2018 ELV statistics from Eurostat[75].

Separately collected LDA at a DCF site

The total reported tonnage was 165kt.

This was calculated from 2022 AATF data and included total separately collected household WEEE and non-household WEEE.

All other sources

The tonnage for all other sources was estimated to be 3,176kt.

This includes the remaining Light Iron that was unaccounted for in the sources outlined above. It was calculated by summing the other sub-flows for Light Iron and subtracting that figure from the total Light Iron in-feed to shredder.

[75] https://www.letsrecycle.com/news/uk-misses-elv%E2%80%AFtarget-for%E2%80%AFthird-consecutive-year%E2%80%AF/

Appendix II; Theft WEEE flows

The total WEEE lost to theft was calculated to be 148 – 164kt (Table 13).

Table 13 Volume of WEEE lost from official collections

Category	2017 (tonnes)	Refresh calculation 2021 report; Total weight lost to theft (tonnes)	
		Value #1 (min)	Value #2 (max)
Large Domestic Appliances (LDA)	89,671	106,232	
Cooling Equipment	7,758	11,925	
Small Mixed WEEE (SMW)	3,201 - 5,335	5,271	8,785
Displays	12,118	25,145	37,708
Total	**114,882**	**148,574**	**164,650**

The refresh of data sources follows the Valpak methodology developed for the 2020 Material Focus study. For full details of this approach and logic to the methodology, please refer to the published report.

The data for theft was updated by recalculating the figures based on updated sources of data.

Large Domestic Appliances (LDA)

The final tonnage for LDAs lost to leakage was 106.2kt.

This work focussed on the leakage of LDAs prior to them being collected from DCF sites as this was recognised as the least secure part of the supply chain and therefore most likely prone to leakage.

For LDAs and Cooling Equipment, updated figures for the total quantities of these items POM from 2008 until 2022 were sourced from official Environment Agency statistics[76]. This data was used to calculate the average ratio between the two categories, whilst also accounting for the difference in the lifespans of the product. If the cooling appliances collection figure is assumed to be the true quantity that would be expected to be collected on site, adjusted for the effect of leakage occurring through compressor and cable thefts, and then the Cooling/LDA ratio collected is applied, the quantity of LDAs that would be expected to be collected can be estimated. The difference between what is reported as collected and what is expected to be collected can then be identified as leakage.

The total tonnage of LDAs and Cooling Equipment collected at DCFs was also updated from the Environment Agency statistics. Using the average ratio between the two categories (previously calculated), the expected tonnage of LDAs collected at a DCF was compared to the actual tonnage that was reported.

The difference between the two (whilst also accounting for total LDAs in Light Iron), was deemed to be the amount of LDA that is lost to leakage.

Cooling Equipment

The total number of units of cooling equipment, and the total tonnage missing (i.e., lost to theft) was

[76] https://www.gov.uk/government/statistical-data-sets/waste-electrical-and-electronic-equipment-weee-in-the-uk

estimated to be 11.9kt.

Cooling equipment lost to theft was calculated using the same methodology as for LDA but using updated figures.

The 2021 Environment Agency statistics were used to update the figures for cooling equipment received at AATFs. Using this tonnage, and the average weights of a single unit of Cooling Equipment for units with and without compressors (these average weights were calculated in the previous report and are used again).

Small Mixed WEEE (SMW)

The estimated tonnage of SMW lost to theft is 5.271 – 8.785kt.

This work focussed on the leakage of SMW taking into account what is placed on the market, recycled, hoarded and lost in other waste streams. SMW figures were calculated using the same methodology but with updated figures.

In order to estimate the quantity of SMW lost through leakage, a top-down approach was used to determine from what is placed on the market, where the flow of SMW be identified. This involved using reported recycling, recycling under exemption, protocolled recycling in other flows (LDAs), hoarding and theft. By estimating these flows, the remainder that is likely to end up in the general waste bin can be identified.

The total SMW POM was taken from the 2021 Environment Agency statistics. The total SMW lost to leakage was found by subtracting the following figures from the total POM:

- Total SMW collected from DCFs, under Reg43, and under Reg50 (all from Environment Agency statistics).
- Cat 2 and Cat 3 Handled but not reported under Exemptions (figures remained the same as previous report).
- SMW lost at site (1.21% of Total Category 1 - LDA Collected from DCFs).

High and low estimates of the total SMW lost to theft were then calculated using two methods:

- 360 Environmental[77] estimates based on Shortfall, and
- Valpak[78] estimate based on Shortfall.

This gave the total SMW lost to theft (5.271 – 8.785kt).

Displays

The total tonnage of displays lost to theft was calculated to be 25.145 – 37.708kt.

This work focussed on the quantifying leakage of display equipment, taking into account the type of displays which are likely and unlikely to be prone to leakage.

The updated figure for Displays POM in 2021 was taken from the Environment Agency statistics. The previous report calculated values for:

[77] https://www.materialfocus.org.uk/report-and-research/theft-of-electrical-waste-from-collection-facilities/

[78] https://www.valpak.co.uk/knowledge-hub-post/eee-flow-2016/

- Average weight of Displays POM.
- The percentage proportions of Display types (cathode ray tube, flat panel, monitors) received by AATFs.
- Average weight per display type.
- Proportion of illegally exported units to Total Units POM.

These values were used again since they are unlikely to have changed. Using these, along with the updated POM data, and data for housing in Great Britain and Northern Ireland, the total tonnage of displays lost to theft was calculated.

Appendix III; Stocks and Flows – Sales and Hoarding

The new analysis covered around 96% of the Eurostat-derived EEE POM in 2021 estimated from near-term forecasts in the Waste Over Time (WOT) model v1.2[79,80]. This included data for all 54 product categories referred to as UNU keys.

The approximately 4% of the WOT POM not included in the new analysis were discarded on the basis of the granular UK product assessment performed by REPIC and Lancaster University in 2018, which considered nearly 800 Common Nomenclature (CN) product types underpinning the WOT data for POM[80].

The previous Material Focus assessment in 2019-2020 only considered 34 UNU keys which were estimated to cover around 73% of the total POM from WOT[81]. The products had been selected on the basis that at least some metadata on times in use and in hoarding, stocks in use and in hoarding, and product fates could be found in published literature.

In the updated assessment, no new metadata for the times, stocks and fates has been sought. Instead, the focus has been on:

- Extrapolating the metadata for the times, stocks and fates from the 34 UNU keys to the remaining 54 UNU keys using reasonable assumptions (see the sub-section below for further details).
- Filtering the WOT POM according to the earlier CN-level UK product assessment.
- Separating second-hand EEE flows from WEEE flows and quantifying the associated second-hand stocks and end of life WEEE.
- Identifying top 10 products (as described by UNU keys) according to units and tonnages in hoarding, units and tonnages flowing into hoarding, and units and tonnages in EEE POM.

[79] Van Straalen, V.M, Roskam, A.J., Baldé, C.P. (2016). "Waste over Time" [computer software]. The Hague: Statistics Netherlands (CBS). Information retrieved 10 August 2017. Available at: http://github.com/Statistics-Netherlands/ewaste.
[80] Stowell, A.F., Yumashev, D. et al. (2018). "Setting robust and realistic PCS targets for WEEE to support the transition to a Circular Economy – an Industry White Paper". Available at: http://dynamicweeemodel.co.uk.
[81] Sayers, M. et al. (2020). "Electrical Waste: Challenges and Opportunities. An investigation into Waste Electrical and Electronic Equipment (WEEE) flows in the UK". Available at: https://www.materialfocus.org.uk/report-and-research/electrical-waste-challenges-opportunities-2/.

- Comparing the resulting estimates for UK's EEE POM and WEEE collected with the relevant Environmental Agency's data.

The updated assessment uses the following datasets:

- EEE POM from the WOT model for 54 UNU keys based on the Eurostat CN-level data between 1995 and 2017, and extrapolations forward to 2021 and back to 1980.
- Mapping protocol between UNU keys and UK14 categories between 1980 and 2021 developed by REPIC and Lancaster University based on CN-level POM data from the WOT model.
- Metadata for times in use and in hoarding, stocks in use and in hoarding, and product fates from the 2019-2020 Material Focus assessment (five separate datasets).
- UK population and number of households provided by the Office for National Statistics.
- Environmental Agency's data for EEE POM and WEEE collected reported by the Producer Compliance Schemes.

Most of the calculations are performed using a specialist software for data analysis, using a model (code) consisting of one main module and nine auxiliary modules and functions. The results computed using the specialist software are written into a summary Excel workbook ("flows_and_stocks_meta_advanced"). The workbook has additional post-processing to output UK totals between 2021 and 2017 and extract top 10 and top 20 products in 2021 according to specified criteria. The interconnected flows and stocks simulated by the updated model are illustrated in table in Appendix III.

Extrapolating metadata on product use, hoarding and other fates to all UNU keys

The extrapolation of the metadata to other UNU keys is based on the following principles:

- For times in use, times in hoarding, stock in use and stock in hoarding, we first derive the averages for the UNU keys in the same century group, e.g. UNU keys 401-408 for consumer electronics, if at least one UNU key within this group has the relevant metadata (see **Error! Reference source not found.**).
- If a given century group doesn't have any relevant metadata, e.g. UNU keys 601-602 for tools (**Error! Reference source not found.**), we then use average across the entire pool (lower confidence).
- We follow a similar approach for product fates, but implement additional corrections for lighting (UNU 501-507), tools (UNU 601-602), medical devices (UNU 801-802), monitoring equipment (UNU 901-902), dispensers (UNU 1001-1002), and solar PV panels (UNU 002).
- The fate corrections for the UNU keys above define recycling rate using an estimate for WEEE Generated from POM and times in use, and the corresponding data for WEEE Collected reported by the Environmental Agency (for the 14 UK categories). The resulting recycling rates are around 15% for lighting and 19% for the specialist product categories above; this compares with an average of 42% across the entire pool of UNU keys with the relevant metadata for product fates (incl. recycling).
- For household lamps and light bulbs (UNU 502, 505 & 506), we also use the available metadata for stock in hoarding to estimate the relevant hoarding rate of around 5% for

these items; we apply the same hoarding rate to portable lights (UNU 501) due to the likely similarities in disposal behaviours.

- We assume, until better data is available, that hoarding rate for specialist lamps (UNU 503, 504 & 501) and for all other specialist product categories listed above is equal to 1%.
- We also assume, until better data is available, that for the specialist product categories above (excl. specialist lamps), the rates of re-use (or donation) and second-hand use are both 5%; this broadly agrees with the relevant averages across the UNU keys with the metadata for fates.
- The rest of the items for the product categories above are assumed to go to general bin (around 80% for lamps and 70% for the specialist product categories).

Table 1. Top 20 products in 2021 according to numbers of units and tonnages.

Top 20 largest entries	Stock hoarded UK (units)	UNU key #	UNU key description	Stock hoarded UK (tonnes)	Average weight per unit (kg)
1	24,083,447	201	Small Household Items (e.g. irons, clocks, adapters)	26,618	1.11
2	20,923,783	401	Consumer Electronics (e.g. headphones, remote controls)	8,160	0.39
3	20,888,486	306	Mobile Phones	1,880	0.09
4	10,722,697	506	Household Luminaires (e.g. light fittings, lamps, Christmas lights)	4,826	0.45
5	6,478,774	405	Speakers	13,865	2.14
6	6,415,745	205	Personal Care (e.g. toothbrushes, hairdryers, razors)	3,542	0.55
7	5,619,695	501	Portable Lighting (e.g. pocket or bicycle lights)	506	0.09
8	5,616,874	303	Laptops & Tablets	6,066	1.08
9	4,374,427	202	Food Preparation (e.g. toasters, grills)	14,311	3.27
10	4,318,769	502	Compact Fluorescent Lamps (e.g. desk lamps)	393	0.09
11	4,118,725	404	Video & DVD	14,021	3.40
12	2,602,836	505	LED Lamps (e.g. desk lamps)	208	0.08
13	2,297,247	408	Flat Screen TVs	23,431	10.20
14	2,119,199	106	Household Heating (e.g. space heaters, ventilators)	23,631	11.15
15	1,429,603	114	Microwaves	32,738	22.90
16	1,409,374	203	Hot Water Preparation (e.g. kettles, coffee machines)	2,566	1.82
17	1,230,608	901	Household Monitoring (e.g. alarms, smoke detectors, thermostats)	310	0.25
18	1,143,148	204	Vacuum Cleaners	6,722	5.88
19	783,056	503	Straight Tube Lamps (e.g. ultraviolet or infrared lamps)	88	0.11
20	636,735	407	CRT TVs	19,104	30.00

Top 20 largest entries	Stock hoarded UK (tonnes)	UNU key #	UNU key description	Stock hoarded UK (units)	Average weight per unit (kg)
1	35,726	104	Washing Machines	492,501	72.54
2	32,738	114	Microwaves	1,429,603	22.90
3	26,618	201	Small Household Items (e.g. irons, clocks, adapters)	24,083,447	1.11
4	23,631	106	Household Heating (e.g. space heaters, ventilators)	2,119,199	11.15
5	23,431	408	Flat Screen TVs	2,297,247	10.20
6	19,673	103	Kitchen Equipment (e.g. ovens, furnaces)	412,771	47.66
7	19,104	407	CRT TVs	636,735	30.00
8	14,709	1	Central Heating (e.g. boilers)	476,787	30.85
9	14,311	202	Food Preparation (e.g. toasters, grills)	4,374,427	3.27
10	14,021	404	Video & DVD	4,118,725	3.40
11	13,952	108	Fridges	342,052	40.79
12	13,865	405	Speakers	6,478,774	2.14
13	13,068	105	Dryers	287,661	45.43
14	10,057	102	Dishwashers	232,262	43.30
15	8,160	401	Consumer Electronics (e.g. headphones, remote controls)	20,923,783	0.39
16	8,045	113	Professional Cooling (e.g. large air conditioners)	75,332	106.79
17	7,793	308	CRT Monitors	381,801	20.41
18	6,722	204	Vacuum Cleaners	1,143,148	5.88
19	6,293	307	Professional IT (e.g. servers, routers, data storage, copiers)	109,604	57.42
20	6,066	303	Laptops & Tablets	5,616,874	1.08

Flows: Into Hoarding

Top 20 largest entries	Flow into hoarding (units/yr)	UNU key #	UNU key description	Flow into hoarding (ton/yr)	Average weight per unit (kg)
1	16,117,269	201	Small Household Items (e.g. irons, clocks, adapters)	17,813	1.11
2	10,485,457	306	Mobile Phones	944	0.09
3	7,722,505	401	Consumer Electronics (e.g. headphones, remote controls)	3,012	0.39
4	6,478,733	506	Household Luminaires (e.g. light fittings, lamps, Christmas lights)	2,916	0.45
5	4,896,624	405	Speakers	10,479	2.14
6	3,945,486	205	Personal Care (e.g. toothbrushes, hairdryers, razors)	2,178	0.55
7	3,532,728	303	Laptops & Tablets	3,815	1.08
8	3,141,209	501	Portable Lighting (e.g. pocket or bicycle lights)	283	0.09
9	2,882,363	202	Food Preparation (e.g. toasters, grills)	9,429	3.27
10	2,629,434	408	Flat Screen TVs	26,819	10.20
11	1,950,326	505	LED Lamps (e.g. desk lamps)	156	0.08
12	1,789,860	404	Video & DVD	6,093	3.40
13	1,759,470	502	Compact Fluorescent Lamps (e.g. desk lamps)	160	0.09
14	1,225,070	106	Household Heating (e.g. space heaters, ventilators)	13,661	11.15
15	1,061,591	203	Hot Water Preparation (e.g. kettles, coffee machines)	1,933	1.82
16	870,767	114	Microwaves	19,941	22.90
17	828,147	901	Household Monitoring (e.g. alarms, smoke detectors, thermostats)	209	0.25
18	711,970	204	Vacuum Cleaners	4,186	5.88
19	309,704	104	Washing Machines	22,466	72.54
20	305,105	1	Central Heating (e.g. boilers)	9,412	30.85

Top 20 largest entries	Flow into hoarding (ton/yr)	UNU key #	UNU key description	Flow into hoarding (units/yr)	Average weight per unit (kg)
1	26,819	408	Flat Screen TVs	2,629,434	10.20
2	22,466	104	Washing Machines	309,704	72.54
3	19,941	114	Microwaves	870,767	22.90
4	17,813	201	Small Household Items (e.g. irons, clocks, adapters)	16,117,269	1.11
5	13,661	106	Household Heating (e.g. space heaters, ventilators)	1,225,070	11.15
6	12,622	103	Kitchen Equipment (e.g. ovens, furnaces)	264,836	47.66
7	10,479	405	Speakers	4,896,624	2.14
8	9,429	202	Food Preparation (e.g. toasters, grills)	2,882,363	3.27
9	9,412	1	Central Heating (e.g. boilers)	305,105	30.85
10	8,267	108	Fridges	202,662	40.79
11	8,120	105	Dryers	178,749	45.43
12	6,928	407	CRT TVs	230,920	30.00
13	6,205	102	Dishwashers	143,301	43.30
14	6,093	404	Video & DVD	1,789,860	3.40
15	5,340	113	Professional Cooling (e.g. large air conditioners)	50,006	106.79
16	4,186	204	Vacuum Cleaners	711,970	5.88
17	3,815	303	Laptops & Tablets	3,532,728	1.08
18	3,012	401	Consumer Electronics (e.g. headphones, remote controls)	7,722,505	0.39
19	2,916	506	Household Luminaires (e.g. light fittings, lamps, Christmas lights)	6,478,733	0.45
20	2,178	205	Personal Care (e.g. toothbrushes, hairdryers, razors)	3,945,486	0.55

Flows: POM (new sales)

Top 20 largest entries	POM (new) (units/yr)	UNU key #	UNU key description	POM (new) (ton/yr)	Average weight per unit (kg)
1	108,680,969	506	Household Luminaires (e.g. light fittings, lamps, Christmas lights)	48,913	0.45
2	98,452,715	901	Household Monitoring (e.g. alarms, smoke detectors, thermostats)	24,824	0.25
3	87,501,704	201	Small Household Items (e.g. irons, clocks, adapters)	96,709	1.11
4	75,054,689	301	IT Equipment (e.g. routers, mice, keyboards, external drives)	30,022	0.40
5	73,719,291	305	Telecom (e.g. cordless phones, answering machines)	33,176	0.45
6	71,421,078	501	Portable Lighting (e.g. pocket or bicycle lights)	6,428	0.09
7	50,983,923	205	Personal Care (e.g. toothbrushes, hairdryers, razors)	28,145	0.55
8	40,192,549	505	LED Lamps (e.g. desk lamps)	3,215	0.08
9	38,603,931	202	Food Preparation (e.g. toasters, grills)	126,290	3.27
10	30,376,549	306	Mobile Phones	2,734	0.09
11	22,920,377	504	Special Lamps (e.g. professional mercury or sodium lamps)	1,700	0.07
12	21,901,318	701	Toys (e.g. electric trains, music toys, biking computers)	9,856	0.45
13	20,087,579	702	Game Consoles	9,726	0.48
14	16,456,046	203	Hot Water Preparation (e.g. kettles, coffee machines)	29,966	1.82
15	13,463,897	303	Laptops & Tablets	14,541	1.08
16	12,095,916	601	Household Tools (e.g. drills, saws, lawn mowers)	30,389	2.51
17	11,782,970	405	Speakers	25,216	2.14
18	11,093,941	408	Flat Screen TVs	113,154	10.20
19	11,030,453	401	Consumer Electronics (e.g. headphones, remote controls)	4,302	0.39
20	10,263,836	106	Household Heating (e.g. space heaters, ventilators)	114,450	11.15

Top 20 largest entries	POM (new) (ton/yr)	UNU key #	UNU key description	POM (new) (units/yr)	Average weight per unit (kg)
1	290,204	104	Washing Machines	4,000,601	72.54
2	171,216	108	Fridges	4,197,490	40.79
3	137,584	103	Kitchen Equipment (e.g. ovens, furnaces)	2,886,789	47.66
4	126,290	202	Food Preparation (e.g. toasters, grills)	38,603,931	3.27
5	114,450	106	Household Heating (e.g. space heaters, ventilators)	10,263,836	11.15
6	113,154	408	Flat Screen TVs	11,093,941	10.20
7	96,709	201	Small Household Items (e.g. irons, clocks, adapters)	87,501,704	1.11
8	91,697	114	Microwaves	4,004,251	22.90
9	83,347	304	Printers	7,672,894	10.86
10	81,074	105	Dryers	1,784,617	45.43
11	79,595	102	Dishwashers	1,838,222	43.30
12	77,455	113	Professional Cooling (e.g. large air conditioners)	725,303	106.79
13	73,837	1	Central Heating (e.g. boilers)	2,393,424	30.85
14	63,337	2	Photovoltaic Panels	3,166,866	20.00
15	53,846	204	Vacuum Cleaners	9,157,470	5.88
16	48,913	506	Household Luminaires (e.g. light fittings, lamps, Christmas lights)	108,680,969	0.45
17	48,294	109	Freezers	1,095,349	44.09
18	38,691	302	Desktop PCs	4,410,526	8.77
19	33,176	305	Telecom (e.g. cordless phones, answering machines)	73,719,291	0.45
20	31,272	404	Video & DVD	9,186,092	3.40

Appendix IV; WoT Stats by year since last report

Table 15: Summary of the new results EEE and WEEE flows and stocks between 2021 and 2017

Flows	2021	2020	2019	2018	2017
POM (new) (units/yr)	899,446,679	883,724,724	874,643,961	870,601,656	869,863,122
POM (new) (ton/yr)	2,194,858	2,155,041	2,117,340	2,081,022	2,045,861
Flow discarded after first use (ton/yr)	1,870,477	1,838,193	1,797,700	1,763,631	1,728,427
Rate of change for stock in first use (ton/yr)	324,381	316,849	319,640	317,391	317,434
Flow into second-hand (ton/yr)	87,553	85,622	82,937	82,578	80,995
Flow discarded after second-hand (ton/yr)	84,066	81,998	80,033	80,365	79,558
Rate of change for stock in second-hand (ton/yr)	3,487	3,624	2,904	2,213	1,437
Flow into hoarding (ton/yr)	256,718	251,565	246,336	243,454	239,498
Flow discarded after hoarding (ton/yr)	245,583	241,018	236,554	234,600	231,473
Rate of change for stock in hoarding (ton/yr)	11,135	10,547	9,782	8,854	8,025
Total WEEE (ton/yr)	1,855,855	1,824,022	1,785,014	1,752,565	1,718,965
Flow "General bin" (ton/yr)	662,304	646,260	629,003	610,004	592,488
Flow "Other" (ton/yr)	307,886	301,728	295,212	288,609	282,093
Flow "Recycling" (ton/yr)	774,125	768,059	756,617	750,849	743,744
Flow "Take-back scheme" (ton/yr)	27,344	26,599	25,849	25,566	25,003
Flow "Unknown" (ton/yr)	84,195	81,376	78,333	77,536	75,637

Stocks	2021	2020	2019	2018	2017
Stock in first use per household (units)	236	238	239	239	239
Stock in first use per household (kg)	623	619	613	602	595
Stock in first use UK (units)	6,757,163,294	6,743,295,243	6,715,549,983	6,663,459,496	6,606,912,661
Stock in first use UK (tonnes)	17,807,064	17,570,459	17,247,638	16,793,735	16,469,949
Stock second-hand per household (units)	4.8	4.6	4.5	4.5	4.3
Stock second-hand per household (kg)	5.2	5.1	5.0	5.1	5.1
Stock second-hand UK (units)	135,984,364	131,324,053	127,741,337	124,774,446	120,244,275
Stock second-hand UK (tonnes)	148,571	143,559	140,995	142,605	140,750
Stock hoarded per household (units)	10.2	10.0	9.8	9.7	9.6
Stock hoarded per household (kg)	15.6	15.3	15.1	15.1	14.9
Stock hoarded UK (units)	290,735,049	282,420,090	276,626,821	271,888,481	264,619,623
Stock hoarded UK (tonnes)	445,704	435,065	425,764	421,814	412,765
EA comparison					
This model POM (ton/yr)	2,194,858	2,155,041	2,117,340	2,081,022	2,045,861
EA POM (ton/yr)	1,922,551	1,824,481	1,720,880	1,548,529	1,614,604
This model WEEE collected (ton/yr)	1,085,510	1,066,673	1,041,110	1,016,984	994,706
EA WEEE collected (ton/yr)	498,331	466,420	505,445	501,262	534,335

About us

Material Focus is a new not-for-profit organisation – our vision is of a world where materials are never wasted.

Three I's inform and guide everything we do: inspiration, investment and insight.

Inspiration
We inspire people to change their behaviour. We do this through our Recycle Your Electricals campaign by revealing the hidden value of the materials in our electricals and by making it feel both easy (and normal) to reuse and recycle them.

Investment
We work with partners to expand the number, and type of collection points, making it easier for everyone to reuse and recycle their old electricals.

Insight
We fund technical research to overcome the barriers to reusing and recycling old electricals. Insight from this research galvanises new and innovative approaches to reuse and recycling, and supports enhancements to the UK waste electrical and electronic (WEEE) system.

MATERIAL FOCUS