London's electricals and electronics footprint

An analysis of material flows, greenhouse gas emissions and levers for action in London

June 2026

ReLondon

DEPARTMENT OF ENGINEERING SCIENCE

UNIVERSITY OF OXFORD

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University of Oxford Department of Engineering Science

The Circular Economy and Sustainability Lab (CESL) seeks to enable the transition to a low carbon circular economy in which product lifetimes are maximised and products and systems are effectively designed for reuse, repair, remanufacture and recycling. CESL adopts a whole systems design approach that jointly considers the full spectrum of circular economy strategies across the life cycle.

ReLondon

ReLondon is a partnership of the Mayor of London and the London boroughs to improve waste and resource management and transform the city into a leading low carbon circular economy. ReLondon's mission is to make London a global leader in sustainable ways to live, work and prosper by revolutionising our relationship with stuff and helping London waste less and reuse, repair, share and recycle more.

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Authors:

University of Oxford Department of Engineering Science

Prof. Lucia Corsini - Head of the Circular Economy and Sustainability Lab

Dr. Ana Outeirinho Morgado – Postdoctoral Research Assistant

ReLondon

Max Russell – Research Advisor

Rachel Shairp – Senior Advisor

Rachel Singer – Circular Economy Advisor

Pauline Metivier – Head of Business and Sector Support

Peer review panel

Robert Holdway – Giraffe Innovation Ltd

Mark Dowling – Giraffe Innovation Ltd

Professor Deborah Andrews – Emeritus Professor of Design for Sustainability & Circularity at London South Bank University

Dr Fabrizio Ceschin – Reader in Design for Sustainability, Brunel University London

Project Board

ReLondon's project board includes representatives from ReLondon, the Greater London Authority (GLA), London Councils' climate change team, and London Councils' One World Living Electronics working group, who acted as the steering committee for this research. Individuals include:

Mike Wood – London Councils

Ravina Singh – London Councils

Tom Harris – Greater London Authority

Yisum Heneghan – Greater London Authority

Isabella Gaggiano – London Borough of Hammersmith and Fulham

Charlotte Akers – London Borough of Hammersmith and Fulham

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Glossary of terms

List of abbreviations

AATF	Approved Authorised Treatment Facility
ATF	Authorised Treatment Facility
BATRRT	Best Available Treatment Recovery and Recycling Technique
CRM	Critical Raw Mineral
DCF	Designated Collection Facility
DTS	Distributor Takeback Scheme
EEE	Electrical and electronic equipment
EPR	Extended Producer Responsibility
HWRC	Household Waste Recycling Centre
LCA	Life Cycle Analysis
MFA	Material Flow Assessment
POM	Placed on Market
POP	Persistent Organic Pollutant
REE	Rare Earth Elements
UNU	United Nations University
WDF	Waste Data Flow
WDI	Waste Data Interrogator
WEEE	Waste electrical and electronic equipment

Carbon emissions Carbon emissions relate to the greenhouse gases that are emitted and are expressed in terms of their equivalent warming potential to carbon dioxide (carbon dioxide equivalents CO_2).

Collection rate The share of WEEE that is collected via formal collection routes. There are two main approaches for defining WEEE collection rate:

- WEEE Generated – Tonnes of formally collected WEEE as a share of the total quantities of WEEE generated/disposed annually, or
- Placed on Market – Tonnes of formally collected WEEE as a share of the average annual tonnes of EEE placed on market over the preceding three years.

For the purposes of this research, the WEEE Generated collection rate is used.

Cradle-to-consumer emissions A partial life cycle assessment covering all greenhouse gas emissions from raw material acquisition, processing, production, and manufacturing, excluding transportation to consumers, use, and end-of-life.

Displacement rate The rate at which acquiring (e.g. buying or renting) or repairing an item through a circular business model directly displaces the purchase of a new item(s) in the existing, linear system.

Emission factor A representative value that relates the quantity of a pollutant released into the atmosphere with an activity associated with the release of that pollutant. Emission factors based on a life cycle assessment would take all of the environmental impacts associated with the entire life cycle of an activity or product into account.

End-of-life emissions Represent the total expected greenhouse gases released from the waste disposal, treatment, or recycling of products. These downstream emissions cover methods like landfilling, incineration, and material recovery.

Greenhouse gas Gases that are capable of absorbing infrared radiation and re-radiating infrared radiation within the Earth's atmosphere. Common greenhouse gases include carbon dioxide, methane and nitrous oxide.

Household Waste Recycling Centre (HWRC) Also known as Civic Amenity (CA) sites, a HWRC is a facility run by a local authority where the public can dispose of household waste. They are often also collection points for recycling and bulky waste.

Major repair EEE that needs major repair work. Parts will be required to repair the item as it is not fully functional, but repair would not be prohibitively expensive.

Placed on Market (PoM) EEE is placed on the market the first time it becomes available for distribution or use in the UK. This includes EEE that is 'formally' registered and reported as per UK WEEE regulation.

This also estimates 'free-riders': a person or company that places EEE on the market for the first time in a specific territory (such as the UK) without registering with a Producer Compliance Scheme (PCS).

Repair The act of replacing, fixing, or adjusting defective components to restore functionality. In this research, a repaired item is considered to return to the original owner for an extended life.

This research also differentiates between two types of repair, defined in WRAP (2011):[i]

Slight repair: EEE needs slight repair, but is in general good condition. The item is slightly damaged, chipped, scratched or casing cracked and would benefit from minor repair work, but is complete and capable of fulfilling the function it was designed for.

Major repair: EEE needs major repair work. Parts will be required to repair the item as it is not fully functional, but repair would not be prohibitively expensive.

Residual waste For the purpose of this report, this refers to waste that is not collected through separate recycling or composting collection rounds. It includes household kerbside residual waste, waste collected at HWRCs, household bulky waste and household street cleaning. That is, household waste that is not prepared for reuse, recycling or composting.

Sankey diagram A flow diagram used to visualise system flows and stocks. The width of the lines in the diagram is proportional to the flow quantity. In this report, the flow lines indicate material and greenhouse gas emission flows.

Slight repair EEE needs slight repair, but is in general good condition. The item is slightly damaged, chipped, scratched or casing cracked and would benefit from minor repair work, but is complete and capable of fulfilling the function it was designed for.

Waste hierarchy The waste hierarchy is a ranking of waste management options according to what is best for the environment. It ranks prevention as the most desirable option, then reuse, recycling and other recovery (including incineration) as the next best options, and finally disposal as the least favourable option.

WasteDataFlow The web-based system for local authority collected municipal waste data reporting by UK local authorities to government.

WEEE Generated & Disposed All WEEE that is deemed to reach the end of its life and is disposed of. This corresponds to all the WEEE that is accounted for through all collection pathways (including formal, and non-official).

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Executive summary

Electrical and electronic equipment (EEE) underpins every aspect of modern life: from fridges, laptops, and smartphones, to buildings' heating and air conditioning equipment, we are increasingly reliant on it in all aspects of our lives.

Globally, new electrical and electronic equipment placed on the market each year is anticipated to increase by 32% between 2022 and 2030 to a staggering 82 million tonnes.[2] Yet these products come with significant material and carbon costs. Waste electrical and electronic equipment is one of the fastest growing waste sources globally, and its production and disposal brings with it a suite of health and environmental impacts: from the mining of rare earth minerals needed to manufacture these items, to the fires caused by batteries disposed of in our waste management system.[3]

The research set out in this report provides the first system-wide analysis of London's electricals and electronics footprint, mapping how these items flow into, through and beyond the capital, as well as quantifying their associated life cycle emissions. It serves as additional evidence to complement ReLondon's other sectoral footprint reports[4], and further compounds the call to action for London to transition to a low carbon circular economy. The research also models the likely carbon reduction impacts of three potential levers that could generate environmental, economic and social benefits across the supply chain.

Key findings:

In 2024, London households and London-based businesses and institutions consumed 255,600 tonnes of new electricals and electronics (EEE) and threw away 134,500 tonnes.

- London's households were responsible for the majority (79%) of London's electrical and electronic product consumption and also accounted for 80% of the items that were disposed of and became waste.

London's households are buying more electricals and electronics than they are discarding.

- On average, each London household bought 57.8kg of new electricals and electronics per year (the weight of one fridge-freezer, or almost 115 smartphones[5]) while only disposing of 30.2 kg (the weight of around 10 laptops[6]). The 'stocks' of electricals within the average London household are therefore increasing: between 2023 and 2024 they grew by 4.4% reflecting the rise in the consumption of these items.
- There is now an estimated 700kg of electricals in the average London home, and likely to be even more in long-term storage. This growing cache of items not in active use represents an opportunity for reuse and redistribution to bring both economic and social value. Efforts to unlock the value of these through repair and/or reuse could displace the purchase of new products, help tackle appliance poverty and reduce the city's electricals and electronics footprint.

In 2024, the production and disposal of electricals and electronics used in London households resulted in the generation of 5.93 million tonnes of CO_2e (around 0.65 tonnes CO_2e per person). (NB: this analysis does not include product use phase and the emissions associated with energy consumption to power these items.)

- This is the same amount of CO_2e that is needed to power approximately 2.1 million homes for a year (more than half of London's households in 2024)[7] even without considering the emissions generated when a product is used (its 'use phase'). When broadened to include products used by London's businesses and institutions, this estimate increases to 9.1 million tonnes of CO_2e, the equivalent of powering an additional 1.1 million homes a year (and a total of 3.2 million).
- The majority (92%) of this carbon impact is generated before products even reach the city, caused by the materials extraction and manufacturing of these items. Making better use of London's existing electricals and electronics through repair, reuse, remanufacturing and effective product management therefore presents an opportunity for reducing London's footprint.
- London's electricals and electronics carbon footprint (excluding use phase) falls between other key sectors, with a larger carbon footprint than both the packaging and clothing sectors but lower than the capital's food system.

Five product categories represent 41.9% of the carbon footprint[8] associated with the production and disposal of household electricals and electronics: small IT equipment, game consoles, flat panel TVs, PV panels and washing machines.

- Despite many of these products being typically small in size, encouraging the repair, reuse and collection of these items could significantly reduce London's electricals and electronics footprint.

In 2024, an estimated 1.7 kgs of electrical and electronic equipment per household were repaired (equivalent to the weight of one laptop), while 8.1 kgs were reused. Taken together, only 21% of products reaching the end of their first life are repaired and/or reused.

- There is an opportunity to increase the amount of electrical and electronic equipment that is reused and repaired across London. Repair and reuse can have a range of benefits, from lowering the carbon footprint of the sector and supporting households experiencing appliance and digital poverty, to supporting green jobs and skills through the repair and refurbishment sector. And there is an opportunity to generate even more impact in London: even without considering the items sitting unused in homes, redirecting those electrical and electronic items that were thrown away by households despite still being in a reusable and repairable condition could almost triple the amount of items repaired (an increase from 1.7 kgs to 4.8 kgs per household), and see a more than 50% increase in the amount of reuse (growing from 8.1 kgs to 12.4 kgs per household).

Of the 134,500 tonnes of items discarded in London in 2024 (by both households and non-households), 47.5% was disposed of via what can be called 'formal' collection routes (such as local authority collections, bring banks and household waste and recycling centres); but a staggering 52.3% (70,700 tonnes) was disposed of via 'improper' routes, with 62.3% of this being put into the residual waste and much of the remaining amount being illegally disposed of through fly tipping or illegal exports.

- Increasing formal collection rates is important not just to increase recycling, repair and reuse rates but also to provide a vital source of critical minerals - such as lithium, cobalt and nickel – and to boost supply chain resilience. Unlocking the value of this 'mine' of materials in the current stock of London's electricals and electronics can play an important role in improving the UK's supply chain resilience and impact.
- Preventing improper disposal can also help avoid battery-related fires in waste management and mitigate other health and safety risks.

Levers to support a lower carbon electricals and electronics supply chain

As part of the mapping of materials and emissions associated with London's electrical and electronic equipment system, the following report also models three potential levers in order to quantify their likely impact and contribution to London's transition to a circular, low carbon and more resilient supply chain.

These levers are all focused on opportunities for London's households, which represent 79% of the electrical and electronic products placed on the market in London in 2024. Each lever has been modelled across two scenarios – moderate and ambitious – to highlight where the greatest reductions in emissions could be achieved at different points across the supply chain. The scenarios are for illustrative purposes and have been set in line with a variety of targets, including collection targets, and other existing sources. The first two levers focus on opportunities for reducing the volume of items being thrown away, with the third lever looking at increasing capture of those items currently disposed of incorrectly.

If the sector were to meet the ambitious scenarios against each of the three levers as outlined below, London could reduce its carbon emissions associated with the sector's supply chain (excluding use phase) by delivering the following actions and impacts:

Lever 1: Increase the reuse of household electricals and electronics to displace new purchases

Impact: By capturing more of those items currently disposed of and diverting those that are in a working and reusable condition, London could reduce the carbon footprint of electricals and electronics (excluding use phase) in London's households by c.4.7% by preventing the emissions associated with their production.

Lever 2: Increase the repair of household electricals and electronics to extend product lifespans

Impact: By capturing and fixing items that are in a repairable condition but are currently disposed of, London could treble rates of repair, resulting in a c.1.3% reduction in the carbon footprint of electricals and electronics (excluding use phase) in London's households. NB: some of these avoided emissions associated with the production of new items may be partially offset by embodied emissions associated with new components that would be needed for repair.

Lever 3: Increase formal collection rates for household electricals and electronics to support repair, reuse and critical minerals recovery

Impact: By increasing the share of waste electrical and electronic items disposed of by households via formal routes to 85%, London could reduce the carbon footprint of electricals and electronics (excluding use phase) by c.1.1% when compared with London's 2024 household baseline. This lever can also play an important role in enabling repair and reuse and increase recycling to provide a local source of critical minerals.

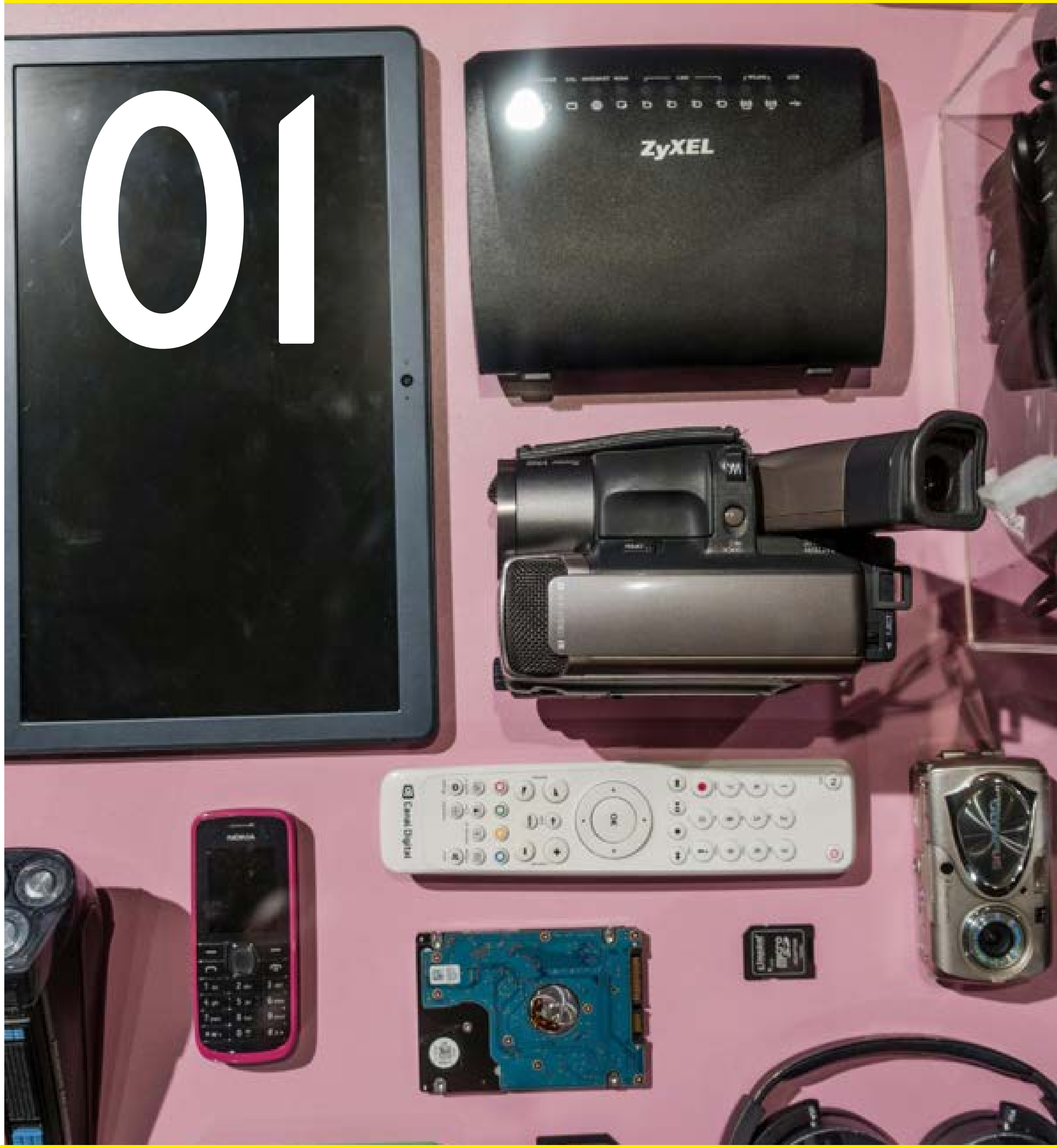
A growing evidence base for action in cities

London's electricals and electronics footprint is the fourth in a series of material flow analyses produced by ReLondon and their partners, with the first being London's food footprint in 2021, the second being London's fashion footprint in 2023, and the third being London's packaging footprint in 2024. These four reports have each applied similar methodologies to quantify sectors' material flows and associated carbon emissions in London; and all four reports propose replicable methodologies to enable other cities to measure and tackle their own consumption-based emissions.

As most major cities globally are net consumers of products and materials, the carbon and waste savings potential from tackling that consumption is significant. In addition to tackling those emissions generated directly within city boundaries (territorial emissions), it is vital for cities to address emissions associated with the materials and resources they consume (consumption-based emissions). London's consumption-based emissions are, for instance, 2.8 times higher than its territorial emissions.[9]

This report presents a practical approach to identify, measure and address electricals and electronic equipment-related waste and carbon hotspots at a city level. It shows the impact cities can have on carbon emissions within their electrical and electronic equipment supply chain through a more circular economy.

Context and aims of the research



1. Context and aims of the research

1.1. Context

While efforts in cities globally have been made to tackle the climate crisis, we are still on course to surpass the 1.5°C threshold of warming within the coming decade.[10] Cities are anticipated to experience acute impacts of our warming climate.[11] Efforts to reduce cities' greenhouse gas emissions have typically focused on the emissions produced directly within the city boundaries (termed 'territorial emissions'), including the energy required to power buildings and industry, heat homes, and fuel transportation networks.

But cities often have a larger, hidden carbon footprint. The materials and products that are consumed in our cities - including food, phones, clothes and cars - each carry an 'embodied' carbon impact. This carbon is related to the greenhouse gases that are emitted during the extraction of raw materials and the manufacture and transportation of products. These emissions contribute to the continued warming of our planet and have a direct impact on our cities through extreme weather events. Taking a consumption-based lens to examine a city's carbon footprint can therefore help to generate insights on which to build a more resilient urban system.

Reflecting the rise of technology and the digitisation of our global society over recent decades, waste electronics (often termed e-waste) is the largest growing global waste stream, with over 62 million tonnes of e-waste generated globally in 2022 – the equivalent of 12 kg per person.[12] What's more, attention is increasingly turning to the importance of material security, particularly materials which are central to electricals and electronics such as critical raw minerals (CRM) and rare earth elements (REE). The sector is positioned at the intersection between the growing demand for raw materials needed to power both the green energy transition and our increasingly digitised societies, alongside increasingly volatile global supply chains.

What is EEE?

The term Electrical and Electronic Equipment (EEE) refers to any household or business item (excluding vehicles) with circuitry or electrical components and a power or battery supply. The term EEE covers any product supplied to the national market for consumption and use by households, businesses, and public authorities. Once EEE is discarded by its owner, it becomes waste and is referred to as Waste Electrical and Electronic Equipment (WEEE, or e-waste).

Electrical product	Electronic product
A device that uses electricity to perform a task or convert electrical energy into other forms of energy. For example, lamps, blenders, and kettles.	A device that stores, transmits or generates information in electronic form. For example, mobile phones, laptops, and speakers.

Amid the growing challenge of e-waste, a circular economy presents a transformative approach to increase material supply chain resilience, reduce ecological degradation, and generate new economic value and jobs at a local level through product innovation.[13 14]

It offers an alternative to the current 'linear' way we produce and consume products and resources, characterised as 'take-make-waste'. In a circular economy, products and materials are kept at their highest value for as long as possible though new design, business models, and infrastructures. Cities, therefore, have a crucial role to play in creating a circular economy.

Recognising the influential role that cities can play in this transition, the Mayor of London has set ambitious targets for Greater London to become a leading net zero carbon city by 2030 and a zero-waste city.[15] Notably, the Mayor of London is striving for a 65% municipal waste recycling rate by 2030.[16]

Alongside this, three-quarters of London's boroughs have set targets to reach net zero emissions by 2030,[17] and to support this ambition, the recent One World Living theme of London Councils' climate programme has supported boroughs in taking action to reduce London's consumption-based emissions.[18] Such commitments demonstrate London's leadership in the transition towards a more sustainable future. Supporting this circular transition, London's Circular Economy Route Map identified five priority sectors that should form the core focus of London's circular transition: food, textiles, plastics, electricals and electronics, and the built environment.[19]

However, evidence is needed to support decision-making, and to increase understanding of the relationship between material flows and their associated emissions, and provide the evidence-base for decision-making. To address this issue, ReLondon commissioned a series of reports to develop an analytical framework for key sectors to support policymaking and inform actions to reduce consumption-based emissions at a city-wide level. The first reports focused on food[20], textiles[21], and packaging[22] flows and their associated emissions, and they were published in 2021, 2023 and 2024, respectively. This report, the fourth in the series, focuses on electricals and electronic equipment (EEE), linking consumption of EEE in London to its carbon footprint.

1.2. A focus on electrical and electronic equipment (EEE)

Our world is an increasingly digital and automated one. Technology is becoming increasingly ubiquitous in all aspects of daily life: from smartphones and devices to monitor our homes and our health and the growth in electrified transport (scooters, bikes, and cars), to the countless appliances that can clean, cook and care for us.

Globally, the production and consumption of electrical and electronic equipment (EEE) has increased over the past few decades.

- The volume of new EEE placed on the market globally reached 96 million tonnes in 2022 and is predicted to reach 120 million tonnes by 2030.[23]
- In the UK in 2024, an estimated 1.9 million tonnes of new EEE were placed on the market.
- EEE are complex items, which often contain a range of critical raw minerals (CRMs). Recognising the growing demand for EEE, the UK's lithium demand is anticipated to increase in the decade between 2025 and 2035 by a staggering 1,100%.
- Rather than seeing product lifespans get longer, there is a trend towards shortening product lifespans. This places additional pressure on global resource extraction and its associated impacts.[24]

In turn, this growth in the consumption and production of new EEE means that e-waste (or WEEE) is now one of the fastest growing waste streams globally.[25] This brings with it significant health and environmental challenges associated with its disposal.

- In 2022, an estimated 62 million tonnes of WEEE were generated globally – an 82% increase from 2010,[26] equivalent to 7.8kg per capita per year.
- Globally only 22.3% of WEEE is formally collected. Since electronic devices contain various assortments of valuable materials, an estimated US$1 billion of strategically valuable resources were dumped in 2022.[27]
- If incorrectly disposed of, the materials contained within EEE can pose significant risks to the environment through the leakage and leaching of harmful chemicals into soils and ecosystems. For example, lithium-ion batteries in residual waste collection pose a risk of combustion. In the UK, fires reported in the waste system increased by 71% between 2022 and 2023.[28]

EEE has been outlined as a priority sector in London's Circular Economy Routemap, recognising the opportunity for circularity to unlock greater value and support job creation, while reducing the environmental impact of the sector.[29]

Recognising the significance of EEE in London, this report explores the flow of electricals and electronics and their associated emissions in order to identify actions which could increase positive outcomes in the city. The insights from this report can help city stakeholders understand where consumption, waste and greenhouse gas emission hotspots are across the EEE system, and where actions should be focused to reduce environmental impact.

1.3. Circularity within EEE

Faced with growth in global demand for electrical and electronic equipment, there is increasing recognition of the myriad environmental and social impacts associated with their production and disposal. As a result, there is increasing pressure for more sustainable design, production and management of EEE. At the global level, the Basel Convention is an international treaty to control the transboundary movement of hazardous WEEE to protect the environment and human health.[30] Organisations are supporting the generation of data and evidence of these global flows of WEEE, such as UNITAR's Global E-Waste Monitor.

Product design and innovation also hold great potential, as it is commonly understood that a significant amount of a product's environmental impact is ultimately determined at the product design stage.[31] Ecodesign regulations, such as those in the EU[32] and the UK,[33] provide a framework to improve the environmental performance of products including EEE.

Recognising the trend towards shorter product lifespans and efforts to curtail the growth in WEEE,[34] global movements for a Right to Repair have helped to establish policy in the UK, the EU and beyond. In the UK the Right to Repair regulation, which forms part of the UK's eco-design regulation, requires manufacturers to make spare parts and technical documentation available for 7-10 years and covers appliances such as large domestic appliances (e.g. washing machines, fridges and TVs).[35]

In the UK, the Waste Electrical and Electronic Equipment (WEEE) Regulations 2013 are the underpinning legislation, outlining the requirements for the correct management and disposal of WEEE.[36] The regulation establishes an Extended Producer Responsibility (EPR) framework whereby producers finance the collection and treatment of WEEE received by local authorities and commercial take-back schemes in the UK.[37] Household WEEE collection targets are calculated for the UK by Defra, the volume of which is apportioned to each Producer Collection Scheme (PCS) based on market share.[38] However, the system

is focused solely on collection and recycling of 'waste' and currently lacks mechanisms to support repair and reuse of items still in circulation.

More recently, the circular economy has been recognised for its relevance in the UK's Critical Mineral Strategy, which outlines the UK's approach towards establishing more resilient supply chains of critical raw minerals.[39] As EEE typically contains a wide inventory of critical raw minerals and precious metals – such as gold, copper, aluminium and other rare earth elements. The UK government has recognised the current stock of electronics in the UK's homes and businesses as a potential source of critical minerals. In particular, the strategy outlines efforts to build "an innovative circular economy to not only recycle, but also reuse, repair and prolong the life of products containing critical minerals, allowing us to fully utilise the second source".[40]

In London, the Greater London Authority and London's boroughs have been implementing a variety of actions to promote a more circular use of EEE across the city and reduce e-waste – for example by installing 'bring banks' on streets, working with initiatives like the Library of Things to encourage circular models of EEE use, and working with social enterprises to refurbish unwanted equipment.

Encouraging and supporting EEE repair has also gained attention in recent years and has been supported by ReLondon and partners:

- The ReCare project explored how Londoners approach repair for their small household electrical and electronic devices via a London-wide survey.
- Funded by the North London Waste Authority and delivered in partnership with boroughs, The Restart Project, ReLondon and FixFirst, the north London repair voucher scheme encouraged the repair of small household items.[41] The first of its kind in the UK, the scheme saw 4,000 north London residents apply for a voucher which offered them 50% off household electrical and electronic item repairs (up to £50).

1.4. Aims and objectives of this project

To date, no research has been carried out to analyse the flows of WEEE throughout London, or to provide an understanding of the associated carbon emissions with these flows.

In response ReLondon and the University of Oxford have collaborated to fill this research gap by adapting the previously developed analytical framework that has been used for London's food, clothing and packaging sector material flow analyses.

This research has mapped the flows of EEE across the city's supply chain and analysed the associated production and manufacturing ('cradle-to-consumer') and 'end-of-life' carbon emissions. The aim of this new evidence base is to enable London policymakers and stakeholders to see where material and carbon hotspots occur and identify levers for reducing these emissions. The research focuses specifically on the emissions associated with the volumes of EEE flowing into London, and the volumes of WEEE generated in the city – and not on the use phase itself. The following report therefore has a clear focus on these upstream and downstream dynamics, and use phase energy consumption and emissions have not been included.

Approach

2. Approach

This section outlines the approach and analytical framework developed to explore the material flows and life cycle emissions of London's Electrical and Electronic Equipment (EEE) system.

2.1. Mapping material flows and emissions: an overview of the approach

The approach provides a baseline 'snapshot' of the flows (tonnage) of materials that flow through London's EEE system. It identifies levers for action to support and unlock a transition to a more circular economy, which in turn can reduce waste and cut carbon emissions. This is achieved by collecting and harmonising the best available data, following the UNU (United Nations University) E-waste Statistical Framework methodology.[42] Results are represented visually in a Sankey diagram. The analysis offers a static 'snapshot' of EEE flows and their associated emissions across Greater London for a given year, in this case 2024, the latest year for which a complete set of data was published.

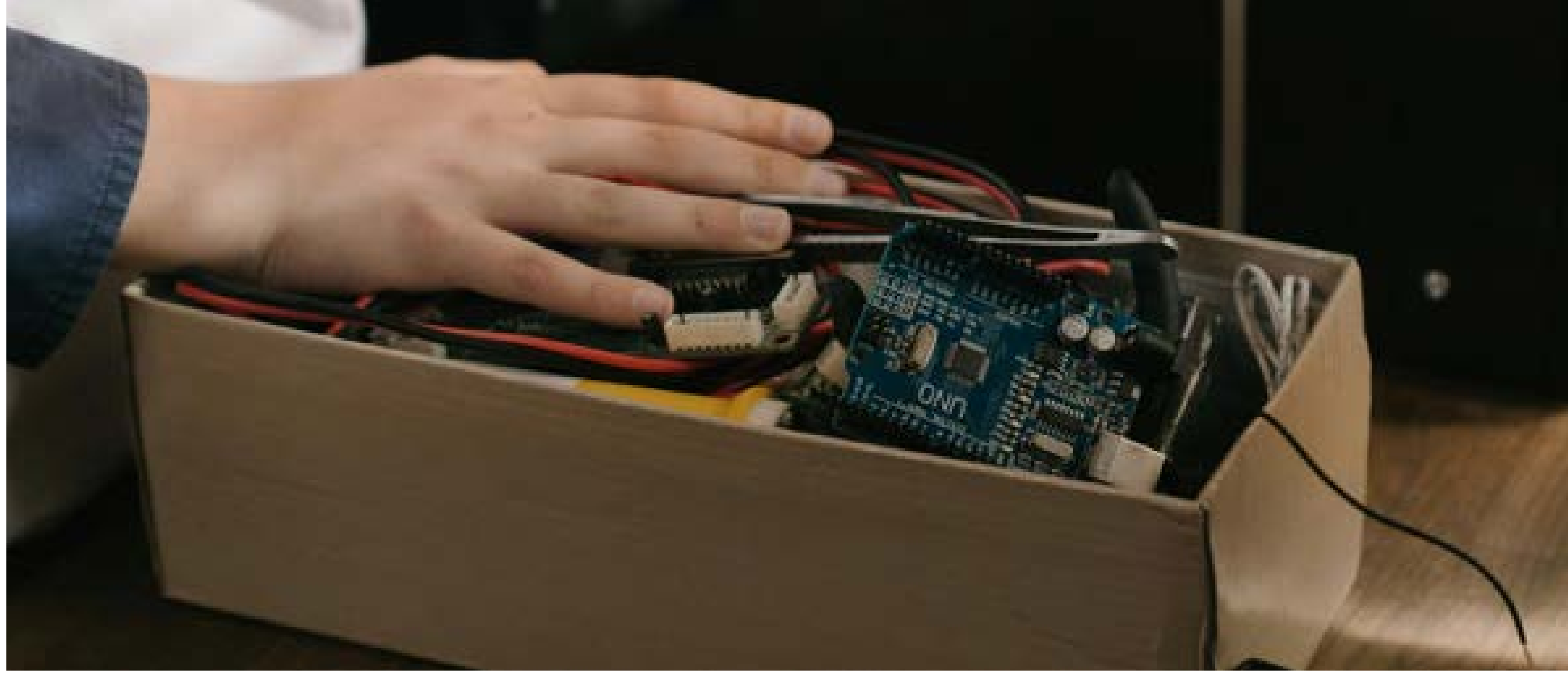
From this static snapshot, section 4 develops 'what if' scenarios that illustrate the potential impacts of increasing circularity across three key levers in London's EEE supply chain.

2.2. Scope of the analysis

The scope of the analysis follows the flows of EEE placed on the market in London in 2024, its use in both London households and non-households (businesses and institutions) in the city, and its potential second life through reuse, repair and remanufacture. The analysis also explores the generation of WEEE, its route of disposal and collection, and its end-of-life treatment.

The key flows that are mapped through the system are:

Flow	Description
Electrical and electronic equipment (tonnes)	The tonnage of electrical and electronic equipment (EEE) placed on the market in London. This covers the UK's 14 EEE categories, including large household appliances (e.g. white goods), display equipment (e.g. TVs), and monitoring and control devices (e.g. smoke detectors) among others. Category 15 Vapes and E-cigarettes are not explicitly considered in this analysis as reporting requirements were put in place in 2025, meaning that data is not available for 2024. In 2024, vapes and e-cigarettes were considered to be part of Category 7 Toys, Leisure and Sport.
WEEE (tonnes)	Waste electrical and electronic equipment (WEEE) that are discarded in London and aligned with the UK's 14 categories.
Greenhouse gas emissions (tonnes CO_2e)	The associated greenhouse gas emissions have been analysed for each of the 54 UNU product categories. Cradle-to-consumer – Emissions associated with raw material extraction, manufacturing, transport and distribution of EEE. End-of-life – Emissions associated with the end-of-life transport, storage and processing of WEEE at the end of its life. For the purposes of this report, use phase emissions have not been included.



The key stages along London's EEE supply chain are:

- **EEE production and imports**: activities related to the extraction of raw materials, manufacturing, and import of EEE into London. There is limited data on the quantities of EEE that are produced within London itself. Consultation with industry stakeholders and experts as part of this research confirmed that such activities are considered marginal, with the vast majority of EEE placed on the market being imported. Data on imported EEE was scaled down from HM Revenues & Customs on UK imports General Trade for 2024.
- **Placed on Market**: the first time new EEE products are placed on the market for distribution or use. This encompasses sales from manufacturers, importers and retail marketplaces.
  - **Reported** – As part of UK Producer Compliance Scheme (PCS) and WEEE regulations,[43] businesses must report the quantities of EEE that are placed on the market.
  - **Free riders** – Entities who fail to register and report their products under the Waste Electrical and Electronic Equipment (WEEE) Regulations. Since 2026, online marketplaces must comply with WEEE regulations,[44] but in 2024 free-riding was a result of online marketplaces or direct sales from abroad.
- **Use and stock**: the use of EEE in London by households and non-households (businesses and institutions). While energy consumption and associated emissions are not covered in this research, the quantities (tonnages) of EEE within the stock are highlighted. This includes both the first use of the product, as well as subsequent use cycles.
- **Second use**: activities relating to the secondary lifespan.
  - **Reuse** – activities related to giving EEE a second life through a new user (change of ownership), preventing it from entering waste streams, including reuse and remanufacturing.
  - **Repair** – activities related to the replacing, fixing, or adjusting defective components to restore functionality back to the original owner. This can take place across community, producer, and high street repair activities.
  - **Refurbishment and/or remanufacture** – activities related to fixing or repairing products back to original, or 'like new' condition. This also includes refurbishment – restoring product functionality. Both imply change of ownership.

- **WEEE Generated and Disposed**: WEEE, whether whole or broken, that is discarded and destined for disposal. This captures the quantities of WEEE that enter the end-of-life system. WEEE is disposed of in several key routes, including:
  - **(Formal) Collection** – activities relating to the separation and controlled collection of EEE from households and non-households in line with UK WEEE regulation. Including both local authority and commercial collection (e.g. retail take-back schemes) to designated collection facilities (DCF).[45] These are generally financed under an EPR system by EEE producers.
  - **Other / non-official collection** - this relates to other disposal routes that are not aligned with national WEEE regulation. These include disposing of WEEE in residual waste, co-mingled scrap metal recycling, and fly tipping.
- **Exports**: exports of EEE products and components from London outside the city boundaries, including to the rest of the UK, the EU and rest of the world. This includes:
  - **Legal** – reported and regulated transboundary movement of WEEE products and components.
  - **Illegal** - unauthorised, transboundary movement of discarded, broken, or non-functional electronic goods. Often disguised as "second-hand" goods to evade regulations.
- **End-of-life management**: activities that relate to the handling and processing of WEEE generated and disposed of in London. This includes facilities outside of the city itself that manage the WEEE that is generated within London. The end-of-life management of WEEE is regulated by national WEEE regulation, which outlines permits and requirements for the treatment and handling of WEEE. Nevertheless, some WEEE is incorrectly disposed of and falls into other waste management streams, leading to health, safety and other environmental risks including fires at treatment facilities.
  - **Recycling** - the processing of waste EEE products, components and materials. Under WEEE regulation, recycling of WEEE must take place at approved recycling treatment facilities (ATF) and authorised approved treatment facilities (AATF). Yet, this analysis also indicates other, non-AATF recycling destinations.
  - **Incineration** - activities to treat waste through thermal combustion, including both with, and without energy capture. Most of the product's value is lost, but activities also include the recovery of metals from incinerator bottom ash.
  - **Landfill** - the disposal of WEEE products or components to landfill sites. Not only is all value lost, but disposal of WEEE in landfill can lead to negative environmental impacts. Batteries, for example, can leak harmful chemicals into the environment.
  - **Other n.e.c** - other waste management activities not elsewhere classified (n.e.c.).
- **Unaccounted**: the estimated quantities of EEE that are unaccounted for in London's EEE system.

2.3. Emissions model

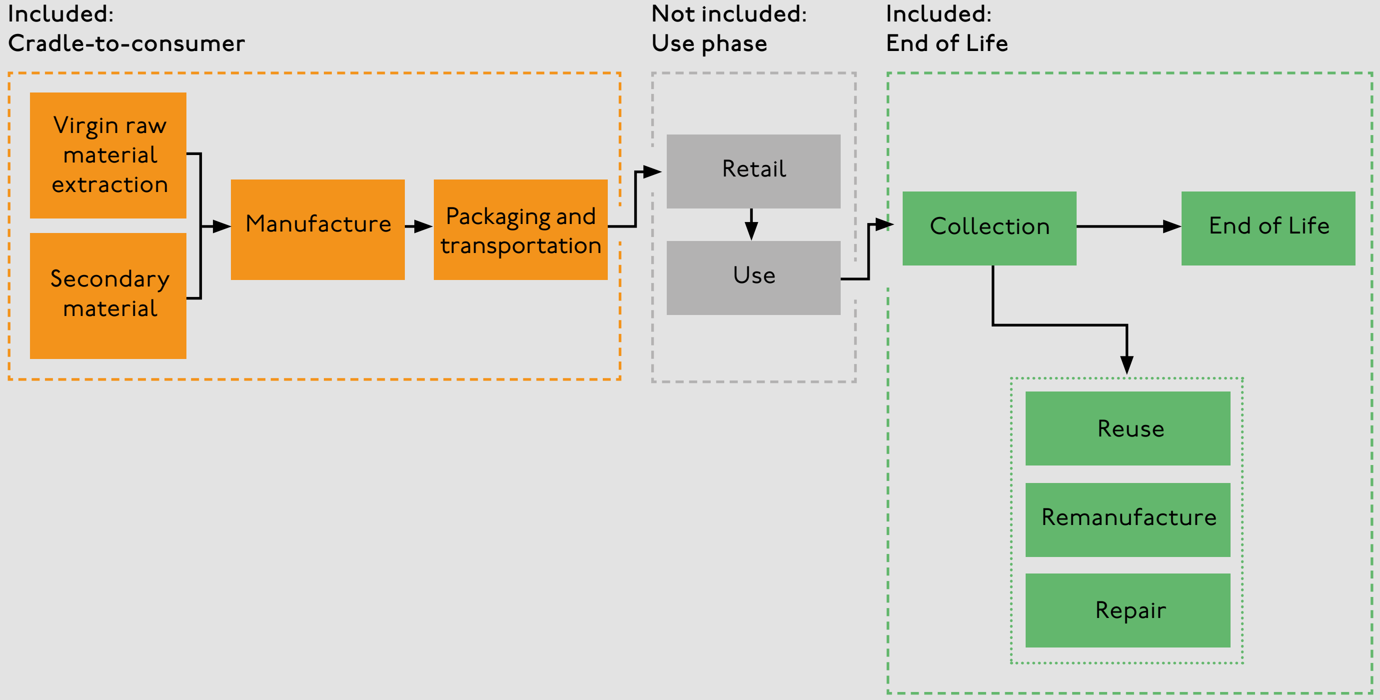
To complement the understanding of the flows of EEE, a carbon footprint assessment was carried out to identify the greenhouse gas emissions associated with London's EEE system.

A Life Cycle Assessment (LCA) was performed, accounting for upstream (Cradle-to-consumer) emissions that are embodied in the EEE from raw material extraction, manufacture, packaging and transportation required to get these products to London. The analysis also focused on the downstream (end-of-life) emissions including WEEE collection, different pathways after end of first use, and end-of-life treatment options. Illustratively, emissions linked to incineration – including with energy recovery - were accounted for to reflect emissions linked with burning WEEE. This analysis was carried out for each of the 54 UNU product categories.

The focus of this study is on emissions associated with material flows and waste management options. For some products, such as washing machines and refrigerators, use phase emissions can typically represent a sizeable share of their life cycle carbon impacts (and can be up to approximately 75%[46]).

Use phase emissions were excluded for two main reasons. Firstly, the inclusion of the use phase energy consumption and associated emissions of 54 UNU product categories is incredibly data intensive. Secondly, excluding use phase emissions allows for clearer identification of products with higher upstream and downstream emissions. In addition, as the UK grid decarbonises, the carbon impact of use phase will decrease, meaning that upstream and downstream emissions should remain as the point of focus.

Figure 1: Carbon modelling scope



2.4. Data availability and limitations

Data quality was assessed using a Data Quality Indicator (DQI) matrix to assess reliability of the source, data representativeness, temporal correlation, geographical correlation, and technological correlation. The assessment indicated that the reliability of the data sources was generally good, since majority of the data were obtained from verified data partly based on assumptions. Data was collected from various sources including the UK Environment Agency, WasteDataFlow, the UK Office of National Statistics, the UNU E-waste statistics, and privately collected data from project partners. The methodology and data were validated through engagement with experts and stakeholders across the EEE value chain, both by conducting structured individual interviews, and in three workshops conducted with industry stakeholders.

Geographical correlation was also rated as good to fair, indicating that the datasets adequately represent the geographical context of the study. Where possible, reliable London-specific data was prioritised. However, where data drawn from wider geographies has been used, it has been scaled to London. Several data sources, such as 'Placed on Market' are reported at the UK scale. These are therefore downscaled to London. In the material flow analysis, scaling for London was carried out in two ways. For households, data was scaled either by population or by number of households, depending on the category (whether the item is owned individually, like a mobile phone, or as a household, like a fridge). For non-households, it was scaled by the number of VAT-registered businesses. Purchasing habits may be influenced by household incomes, which might vary regionally; however, due to limited data availability, London-specific purchasing habits and incomes have not been considered within this research.

The temporal correlation of the data was assessed as good to fair, reflecting that data for the year of 2024 was prioritised. Where data for the year was not available, efforts have been made to extrapolate this data to 2024 or use the most recent available data. All assumptions were validated with stakeholders and represent best available data. While most datasets are reasonably current, some of Life Cycle Inventory data may not fully correspond to the reference period of the assessment. "In contrast, data representativeness was rated as fair to poor, as some data was scaled from a smaller number of sites and for shorter periods, or assumptions were made where incomplete data sets existed. Reuse and repair activities are not consistently reported across the industry. The estimates used in this research are established from bottom-up data sources, such as Repair Café, and the North London Repair Voucher scheme) and estimates that are scaled to London. The available data tends to favour household reuse and repair, and as such, it is assumed that non-household reuse and repair may be under-represented within this research.

While WEEE disposed of in formal collection and disposal routes is reported and captured as part of alignment to the UK's WEEE Regulations, where WEEE is not disposed of correctly in formalised disposal routes, estimates are developed using available datasets.

The UNU E-waste statistics methodology was used to estimate the quantities of EEE in its use phase and product lifetime using Weibull distribution functions. This methodology does not consider the quantities of EEE that remain in long-term storage after the end of its life (in other words, the items that have broken but remain in storage, such as in household cupboards). Research suggests that households could each have around 10 items in long-term storage.

The lowest ratings were observed for technological correlation, which ranged from poor to very poor. The Life Cycle Analysis relied on proxy and generic Life Cycle Inventory where more specific information was unavailable.

Overall, the assessment highlights strengths in source reliability and geographical relevance, while indicating notable uncertainties associated with data representativeness and technological correspondence. These limitations should be considered when interpreting the LCA results and drawing conclusions from the study. That said, this research provides an important understanding of electricals and electronics across London from both a weight and greenhouse gas emissions perspective.

The table in appendix 1 outlines the key data sources that have been used and provides an indication of data quality. This table provides a useful reference to support the interpretation of the results and indicates where caution is recommended.

The material flow and emissions of electrical and electronic equipment in London

03

3. The material flow and emissions of electrical and electronic equipment in London

This section presents detailed findings from the material flow analysis of EEE throughout London, along with its associated emissions.

Subsection 3.1 presents a summarised view of London's EEE supply chain and emissions indicators to highlight characteristics of London's EEE system. Subsection 3.2 then provides a more detailed description of each stage of London's EEE system through a Sankey diagram. All data points shown in this chapter have been rounded to the nearest one hundred tonnes. Subsection 3.3 provides a detailed description of the greenhouse gas emissions associated with EEE flows within London.

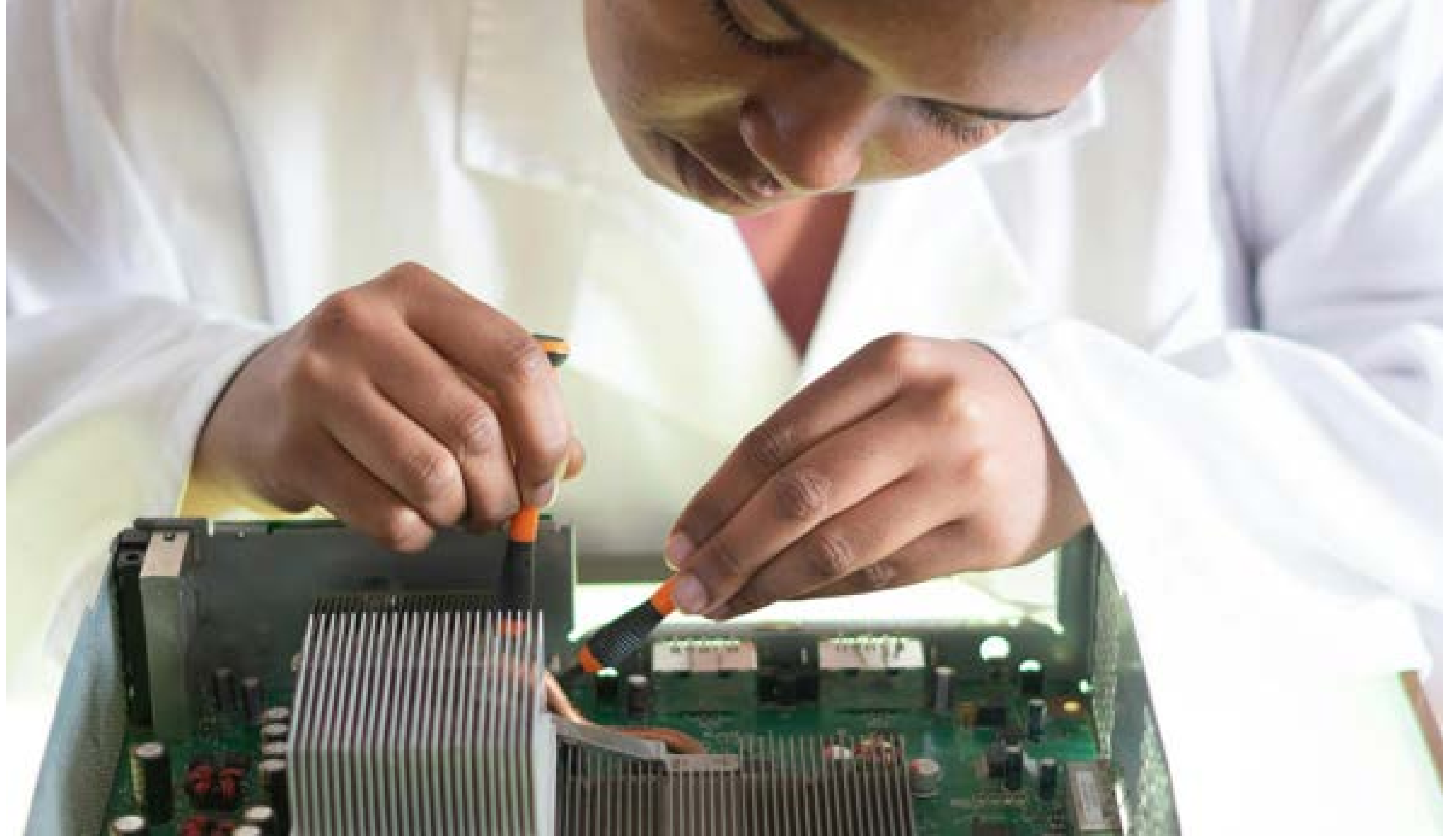
3.1. London's EEE system at a glance

London's total consumption of electrical and electronic equipment in 2024 was 255,600 tonnes. 79% of this was consumed by households versus 21% consumed by businesses and institutions (non-households).

- This is the total amount of EEE that was placed on the market in London in 2024 across both households and non-households (including businesses and other institutions). It includes products that are manufactured in other parts of the UK, the EU and around the world and imported to be used in London.
- Approximately 79% of that total (202,200 tonnes) was consumed by London's households. This is equivalent to an average 22.2 kg per person, or the weight of seven laptops plus two mobile phones.[47] The remaining 21% (53,400 tonnes) was consumed by businesses and institutions (non-households), and includes items such as ventilation and cooling equipment, mechanical tools and IT equipment.

London's household EEE production and disposal emissions (excl. use) in 2024 was 5.90 million tonnes CO_2e – lower than London's food system emissions, but significantly higher than packaging or clothing.

- These were the total emissions associated with the life cycle of EEE consumed in London (excluding the use phase) in 2024. These emissions occur both within the city itself, such as in logistics and waste management activities, as well as outside of the city boundaries, particularly in the material extraction and manufacturing of EEE for use in London. In this model, the upstream emissions are allocated to the final consumer of the item (households and non-households in London rather than the original producer of these emissions). Scaling this to include non-household EEE increases this estimate to 9.10 million tonnes of CO_2e.
- When compared with London's other main material streams, these total emissions (9.10 million tonnes CO_2e) are lower than London's food system (15.48 million tonnes CO_2e) but significantly higher than packaging (4.12 million tonnes CO_2e), and clothing (2.01 million tonnes CO_2e.) supply chains. It should be noted that this total includes emissions from both households and non-households in London, which is different from ReLondon's material flow analyses of London's food and fashion footprints, both of which primarily focused on households.

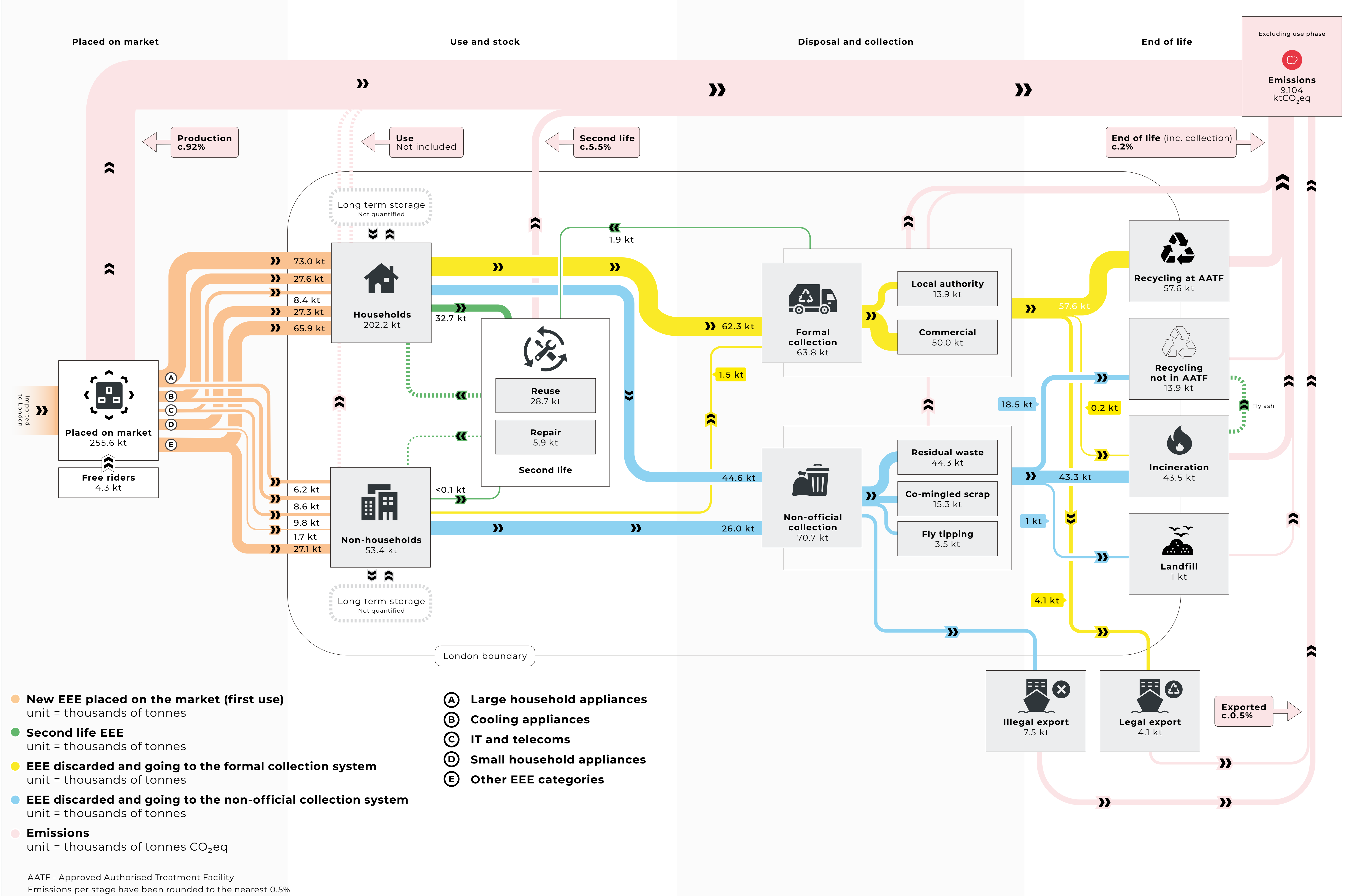


The amount of WEEE generated and disposed of in London in 2024 was 134,500 tonnes – 80% of which was generated from London's households versus 20% from non-households.

- This refers to the EEE products and components that were discarded into end-of-life waste management systems and became waste (WEEE) in 2024. WEEE is generated by both household and non-households.
- An estimated 80% of the WEEE that was generated and disposed of (106,900 tonnes) came from London's households. This is equivalent to approximately 11.8 kg per person (about the same weight as a vacuum cleaner[48]), or 30.2 kg per household (the weight of an under-counter fridge[49]).
- The remaining 20% (27,600 tonnes) of WEEE generated and disposed of in London relates to non-household uses such as businesses, other industry and institutions.

3.2. EEE material flows and associated life cycle emissions

The following Sankey diagram illustrates the journeys of EEE consumed within London. The diagram flows from left to right and indicates how electricals flow through the key stages of London's EEE system: from being placed on the market and used by households and non-households in their first and subsequent use phases, through being disposed of in formal and non-official collections and management routes, and finally to their end of life management destination, including recycling, incineration or landfill. The Sankey diagram indicates the quantity of EEE at each stage of the value chain and the emissions associated with each of these stages.



Placed on market
Use and stock
Disposal and collection
End of life
Excluding use phase
Emissions
9,104
ktCO2eq
Production
c.92%
Use
Not included
Second life
c.5.5%
End of life (inc. collection)
c.2%
Imported to London
Placed on market
255.6 kt
Free riders
4.3 kt
A
B
C
D
E
73.0 kt
27.6 kt
8.4 kt
27.3 kt
65.9 kt
6.2 kt
8.6 kt
9.8 kt
1.7 kt
27.1 kt
Long term storage
Not quantified
Households
202.2 kt
Non-households
53.4 kt
Long term storage
Not quantified
32.7 kt
<0.1 kt
1.9 kt
Reuse
28.7 kt
Repair
5.9 kt
Second life
62.3 kt
1.5 kt
44.6 kt
26.0 kt
Formal collection
63.8 kt
Local authority
13.9 kt
Commercial
50.0 kt
Non-official collection
70.7 kt
Residual waste
44.3 kt
Co-mingled scrap
15.3 kt
Fly tipping
3.5 kt
57.6 kt
18.5 kt
0.2 kt
43.3 kt
1 kt
4.1 kt
Recycling at AATF
57.6 kt
Recycling not in AATF
13.9 kt
Fly ash
Incineration
43.5 kt
Landfill
1 kt
London boundary
Illegal export
7.5 kt
Legal export
4.1 kt
Exported
c.0.5%
New EEE placed on the market (first use)
unit = thousands of tonnes
Second life EEE
unit = thousands of tonnes
EEE discarded and going to the formal collection system
unit = thousands of tonnes
EEE discarded and going to the non-official collection system
unit = thousands of tonnes
Emissions
unit = thousands of tonnes CO2eq
A Large household appliances
B Cooling appliances
C IT and telecoms
D Small household appliances
E Other EEE categories
AATF - Approved Authorised Treatment Facility
Emissions per stage have been rounded to the nearest 0.5%

London's EEE supply chain

3.2.1. Placed on the market

- **255.6k tonnes of new EEE were placed on the market in London – the equivalent to 22.8 kg for each Londoner (or the same weight as three vacuum cleaners)**[50]

In 2024, 255,600 tonnes of new EEE were placed on the market (POM) in London. The vast majority (98.3%) of this is recorded and registered in accordance with the UK's WEEE Regulations 2013. However, an estimated 4,300 tonnes (1.7%) of EEE were placed on the market in 2024 by 'free riders' entities who fail to register and report their products. These free riders can include non-UK sellers without a legal entity in the UK and who use online marketplaces to sell products, such as small electronics, directly to consumers.[51]

- **79% of total EEE placed on the market was intended for households, with large household appliances representing the largest category in households**

Of the total quantity of EEE placed on the market in London, 79% was intended for households, equivalent to approximately 22.8 kg per person. Large household appliances – including household white goods such as washing machines and dishwashers - represented the single largest category consumed by London households by weight, followed by small household appliances and cooling appliances containing refrigerants (such as fridges and freezers) (Table 1).

- **Non-households represented the remaining 21% of EEE placed on the market, with IT and telecoms being the largest category, followed by cooling appliances**

Non-household use represented the remaining 21% (52,200 tonnes) of new EEE placed on the market in London in 2024. As can be seen in Table 1, IT and telecoms equipment represented the single largest category by weight (18% of total non-household EEE placed on the market). This was followed by cooling appliances containing refrigerants (such as fridges and freezers), which represented 16% of new non-household EEE placed on the market by weight.

- **Per person, the amount of EEE placed on the market in London is lower than the UK average**

When looking at the amounts of EEE placed on the market per person, London (22.8 kg) is estimated to be lower than the UK average (26.9 kg per capita).[52] London's lower amount compared with the UK average is likely to be the result of London's larger average household sizes where items such as fridges and electric cookers are likely to be shared between more people. However, due to limited data, more detailed household consumption patterns were not considered.

Table 1: Top three EEE categories placed on the market (tonnes) in 2024 for households and non-households

Rank	Households		Non-households	
1	Large household appliances	73,000 t (36%)	IT and telecoms equipment	9,800 t (18%)
2	Cooling appliances containing refrigerants	27,600 t (14%)	Cooling appliances containing refrigerants	8,600 t (16%)
3	Small household appliances	27,300 t (14%)	Lighting equipment	6,700 t (12%)

- **The majority (92%) of carbon emissions associated with the flows of electrical and electronic equipment (excluding their use phase) are caused by material extraction, manufacturing and transportation**

Looking at the carbon emissions associated with the 202,200 tonnes of household EEE that was placed on the market in 2024, 5.42 million tonnes of CO_2e were embodied within the EEE that was placed on the market in 2024. This relates to the emissions that are generated before EEE reaches the city as a result of raw material extraction, manufacturing and transportation (cradle-to-consumer). Although the specific share varies across different products, put together for EEE placed on the market, these embodied emissions represent 92% of the life cycle emissions excluding their use phase. The emissions associated with the production and consumption of new EEE therefore represent a critical emissions hotpot and area of potential intervention to mitigate the total footprint of London's EEE supply chain.

- **Small IT equipment is the most emissions-intensive product category to produce**

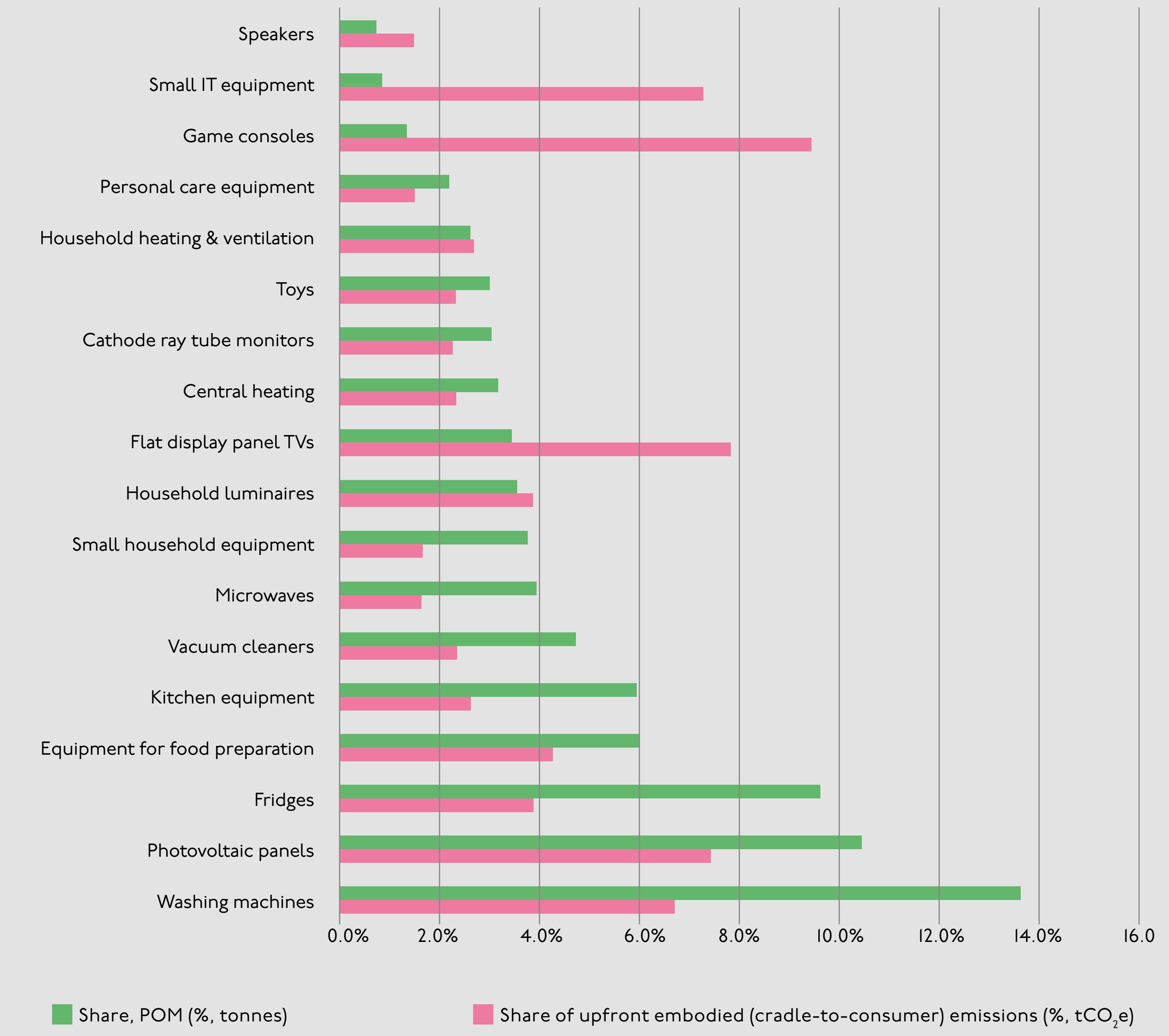
Figure 3 zooms into more detail and highlights a selection of the 54 UNU product categories that have been modelled to provide an overview of the relationship between the physical flows of EEE placed on the market in London for households, and its associated upstream embodied (cradle-to-consumer) emissions.

There is a disproportionate difference between weight and emissions for some of the most significant products. For instance, small IT equipment is the most emissions intensive product when it comes to production, representing just 0.9% of the equipment placed on the market for households in 2024, but represents 7.3% of the production-related emissions in the same year.

As a result of this disproportionate carbon impact, any efforts to reduce the number of new items produced (through for example repair, remanufacture and reuse) have the potential to avoid these emissions.

Zoom-in – The production of household EEE

Figure 3: Comparison of selected UNU product categories for total household POM (tonnes) and upstream embodied (cradle-to-consumer) emissions (tonnes CO_2e)



3.2.2. Use and stock

- **73% of the electrical and electronic equipment in use and stock in London are within households, versus 27% in businesses and institutions**

  An estimated 3.43 million tonnes of electronics were in use (in stock and in operation) across London in 2024. Approximately 73% (2.49 million tonnes) of this was in London's households, with non-households responsible for 27% (approximately 0.94 million tonnes).

  While the use phase energy consumption and associated emissions is not the focus of this research, this phase nevertheless represents an important part of the overall picture. While energy efficiency has continued to improve over the past decade, research suggests that due to the large carbon footprint associated with the manufacture and production of EEE, extending the lifespan of existing products is, in almost all cases, preferable to replacement.[53 54] In other words, the incremental use phase emission savings of a more efficient product are typically outweighed by the emissions required to manufacture the new product.

- **The amount of electrical and electronic equipment in London households is growing – increasing by 4.4% between 2023 and 2024**

  On average, each household in London contains approximately 702kg of EEE in their current stock – corresponding to approximately 300 individual items including bulkier items such as white goods, to small individual items like lightbulbs and headphones. Large household appliances represented approximately 40% of this estimated EEE stock in households by weight.

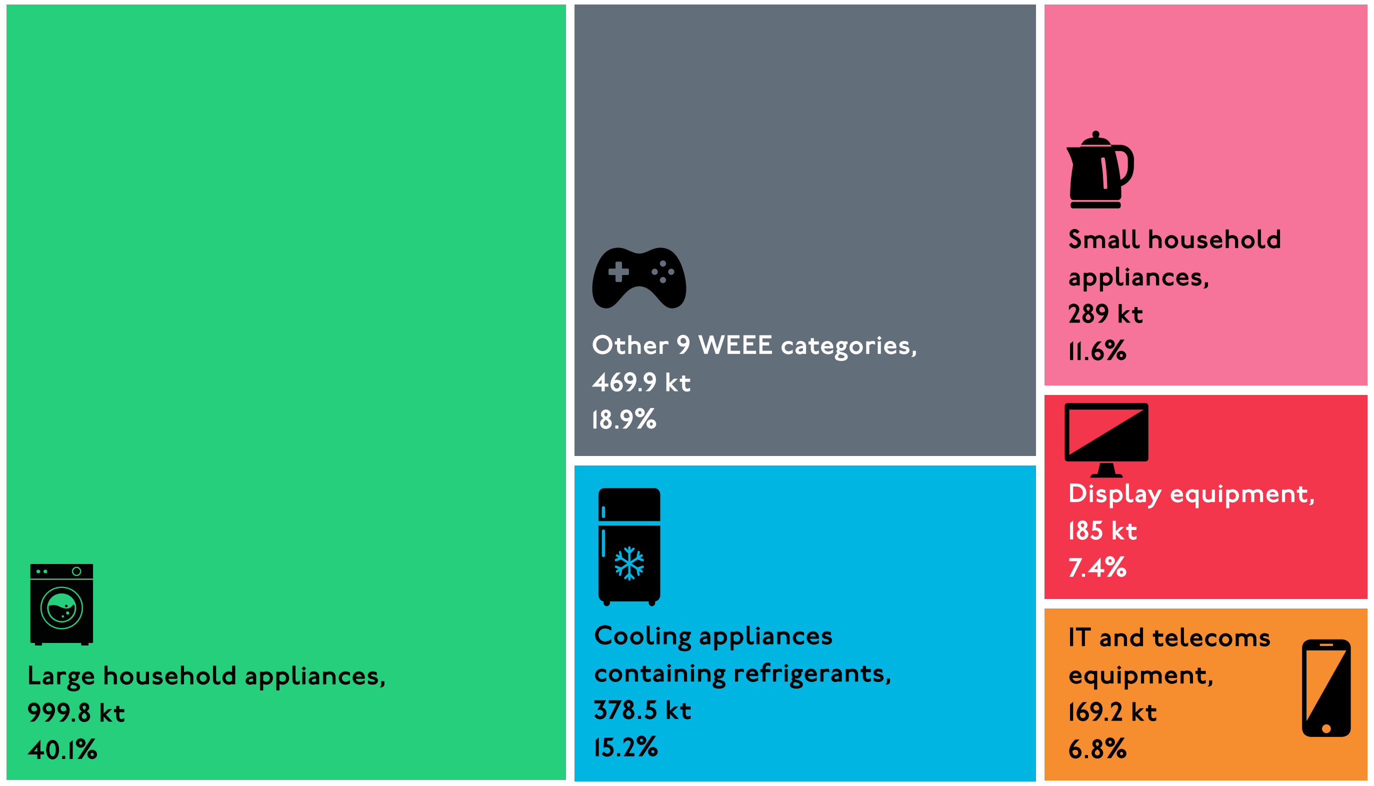
  While this EEE may not be in active use - for example some items may be in hibernation or long-term storage- as they are no longer wanted or needed - this represents an important opportunity to ensure each item is maintained at its highest value for as long as possible (through reuse and repair), and managed effectively at the end of its lifespan.

- **IT and telecoms equipment make up over a quarter (27.5%) of the products in use and stock in London's businesses and institutions**

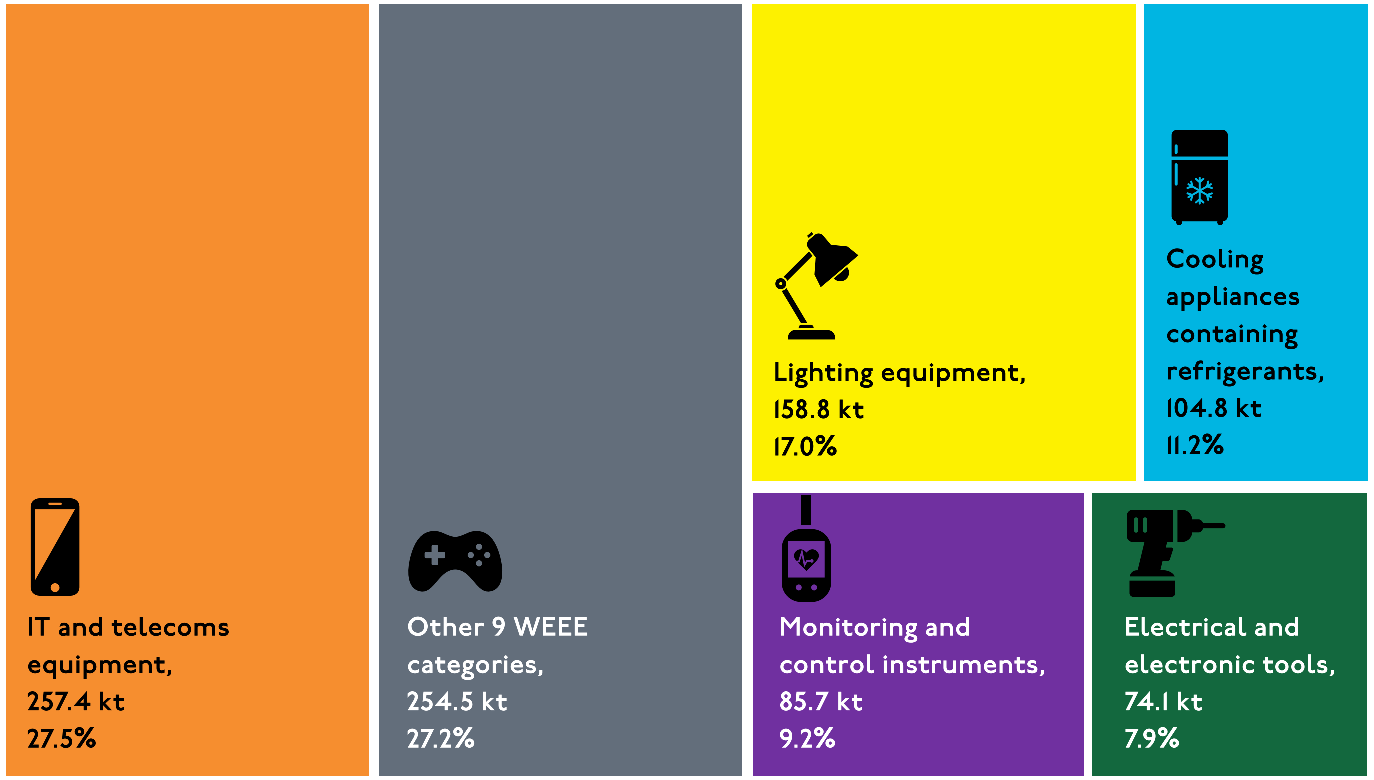
  Electrical and electronic equipment plays an important role in the day-to-day functioning of London's economy. The single largest EEE category that is estimated to be in the stock of London businesses and institutions is IT and telecoms equipment – such as laptops and phones – which in this study represented approximately 27.5% of EEE in use by businesses and institutions (non-households).

Figure 4: Top 6 categories of EEE in first use in households and non-households (percentage, tonnes)

Household stock



Non-household stock



3.2.3. End of first life

Whether the product is broken and requires maintenance to continue to function, or it is no longer needed or desired, ultimately each product reaches the end of its first life. This represents a critical point in the life cycle of EEE. The estimated lifespan of products varies by the type of product and the intensity of its use.

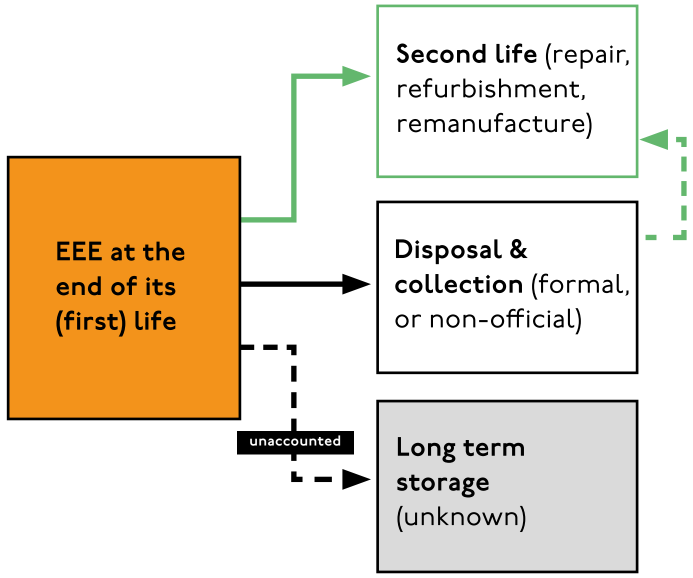
- **18 kg of London's electrical and electronic equipment per person reached the end of its first life– which is lower than the UK average**

  In 2024, 168,900 tonnes of EEE reached the end of its first life. This is equivalent to 18.0 kg per person (or the same weight as a microwave[55]). This is lower per person than the estimates for the UK (24.5 kg per person[56]). Likely, this is partially a result of larger average household sizes in London when compared to the rest of the UK,[57] and as such, bulkier household items, such as fridges, washing machines, and televisions are shared between more people, on average. When EEE reaches the end of its first life, three key pathways are possible (illustrated in Figure 5).

  - **Long-term storage** – EEE is not in active use but is not disposed of. For example, kept in hibernation in household drawers. This could be in a working condition or could require some adjustments.
  - **Second-life – the product is kept in use through reuse, repair and/or refurbishment.**
  - **Disposal** – EEE is discarded by the owner, either through formal routes or other non-official pathways.

Due to WEEE regulations, and the controlled management and disposal of WEEE, once EEE is classified as waste it becomes difficult to redirect to a second life. From a value retention perspective, this stage in the life cycle represents a critical point to keep EEE at its highest value for as long as possible.

Figure 5: Schematic for the three choices at the end of the first life of EEE.



- **94% of the electrical and electronic equipment reaching the end of its first life went to waste collection routes, meaning a sizable amount was not thrown away**

  Of the 113,700 tonnes of household EEE reaching the end of its first life in 2024, 94% was accounted for in disposal routes (both formal and non-official). Conversely, 6% of EEE that was estimated to come to the end of its first life in 2024 was unaccounted for. It is likely that this EEE goes to the other two pathways, either to a second life, or to long-term storage.

- **Over half (c.55%) of the non-household equipment reaching the end of its life was not accounted for in waste disposal estimates, representing an important data gap**

  Across the 50,200 tonnes of non-household EEE reaching the end of its first life, a much lower share (c.55%) was accounted for in disposal routes. Due to data limitations, this represents an area of uncertainty in London's EEE supply chain. This accounting gap suggests there may be other professional waste management routes, such as those delivered by third-party IT Asset Management & Destruction (ITAM/ITAD) firms, which may be situated outside of the city's boundaries. This represents an important area of further exploration.

3.2.4. Long term storage

- **There is likely a large amount of electrical and electronic equipment lying dormant in long-term storage across London, presenting a potential opportunity to capture value**

  When an EEE item has reached the end of its (useful) life, rather than sending to disposal or to a second life, items are kept and placed in storage within the household e.g. in drawers, cupboards and garages.

  Due to data limitations, long term storage isn't quantified here – but research by Material Focus estimates that each household could have an estimated 10 items of EEE in long term storage at home.[58] This is predominantly smaller domestic appliances (mobile phones, batteries and accessories). While not quantified in this report, these items nevertheless represent an 'urban mine' of items and materials (such as metals and critical raw materials) that could be recirculated back into the economy, whether through reuse or material recovery and recycling.

3.2.5. Second life

(a) Second life - reuse and refurbishment

- **On average each Londoner sent 3.2 kg of electrical and electronic equipment to reuse (the same weight as a laptop), but threw away almost four times more (12.1 kg per person)**

  According to estimates, approximately 28,680 tonnes of EEE were reused in London in 2024. Due to limited data, these estimates are primarily focused on household reuse of EEE. (Figure 6) Despite data being limited, Table 2 outlines three main reuse pathways in London.

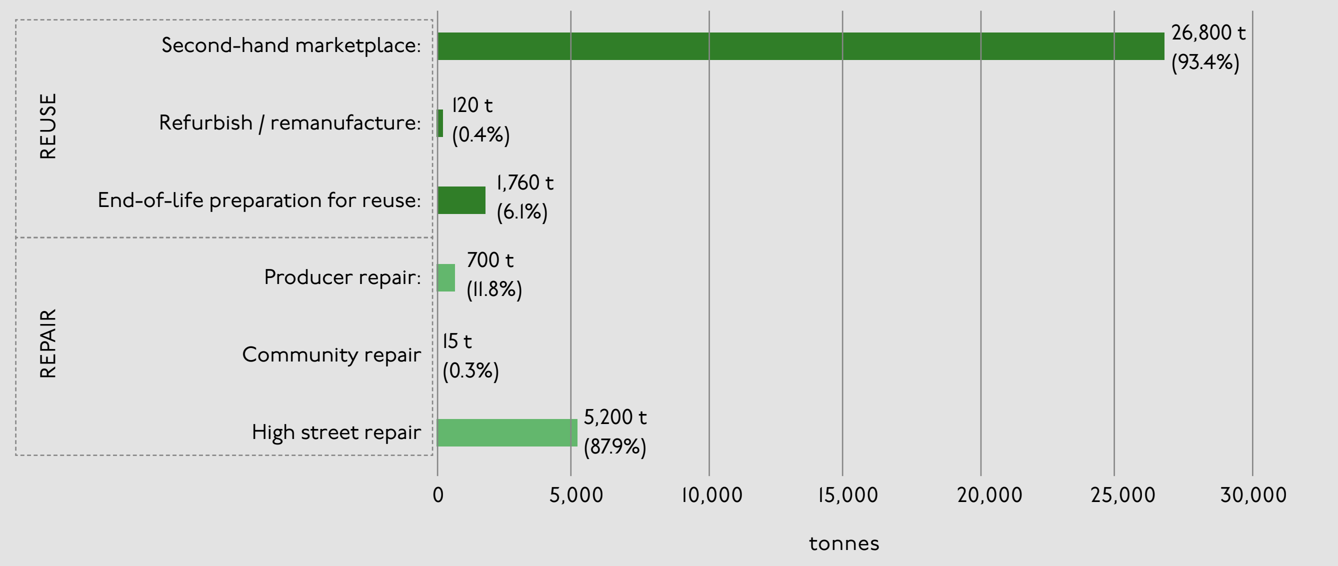
Table 2: Three main reuse routes in London

Reuse pathway	Description	Quantities reused, 2024
Second-hand C2C market reuse	Reuse that occurs directly between consumers (consumer-to-consumer, or C2C), often facilitated by online platforms like eBay, Gumtree and Olio. Items are typically sold 'as-is' with no re-warranty or verification performed on the item.	26,800 tonnes
Refurbishment	Unwanted items are sent, often through formal collection routes like takeback schemes, and go through a quality inspection process to ensure that they are functioning in an assured working condition ('like new').	120 tonnes
End-of-life preparation for reuse	Similar to refurbishment, reusable devices are identified as reusable and diverted. This can occur via 'bring banks' at household waste and recycling centres (HWRCs) or through partnerships with social initiatives, such as Groundwork's REWORK[59]. Products are checked and cleaned so that they can be reused without any other pre-processing. Devices are identified and diverted to reuse prior to their formal classification as WEEE.	1,760 tonnes

- **Each year, London's households throw away 16,160 tonnes of equipment that is in a directly reusable condition – representing 15% by weight of the items that were thrown away in 2024**

  Bringing items to a 'like new' condition through refurbishment can instil a greater degree of trust and assurance by adding a verified condition (and even extended warranty) for second-hand EEE. Nevertheless, each year, EEE gets disposed of that is in directly reusable condition.[60] [61] There is an opportunity to redirect these items, and capture and maintain their value at for as long as possible (Section 4.1).

Figure 6: Reuse and repair of EEE per pathway (tonnes)



(b) Second life – repair

Through everyday use, products can become damaged or break. A variety of repair options are available in London (Table 3). Due to the limited data on repair activities, estimates are primarily focused on households rather than repair, maintenance and servicing of EEE in non-household (across London's businesses, industry and institutions); these non-household repair activities are important, but the values provided for them in this study are likely to be an underestimate.

- **Just 5% of household electrical and electronic equipment reaching the end of its first life was repaired**

  In 2024, it was estimated that London's households repaired approximately 5,915 tonnes of EEE (equivalent to 1.7kg per household, approximately equivalent to one laptop). This corresponds to approximately 5% of household EEE that reaches the end of its first life being repaired to extend its use (Figure 6). Table 3 outlines the three main repair routes in London.

Table 3: Three main repair routes in London

Repair pathway	Description	Quantities repaired, 2024
Producer (in-warranty) repair	Repair that is carried out by the producer / manufacturer of the EEE within the warranty period (a minimum of six months in the UK, but customers can make a claim up to six years after purchase).	700 tonnes
Community repair	Repair that is carried out within the community at voluntary community events such as Repair Cafes, which are often temporary or semi-regular in nature (e.g. once a month).	15 tonnes
High street repair	Repair that takes place in dedicated repair shops on the high street. This high street repair typically focuses on the repair of higher value goods, such as smaller household appliances and IT and telecommunications equipment (such as mobile phones and computers). The estimate for the quantities of products repaired is assumed to underestimate repair carried out by call-out repair services for larger items such as white goods.	5,200 tonnes

- **Almost double the amount of repairable EEE was thrown away than was repaired in 2024**

  There is evidence that Londoners dispose of a significant amount of EEE that is in a readily repairable condition.[62] Based on estimates on the condition of EEE disposed of by households, approximately double the amount of EEE was thrown away in a repairable condition (11,200 tonnes) than was repaired by London households in 2024 (5,915 tonnes). There is therefore an opportunity to promote the repair of such items to extend their usable lifespans.

3.2.6. WEEE generation and disposal

- **A total of 134,500 tonnes of WEEE was generated and disposed of in London in 2024.** This total includes the quantities of items that were disposed of; both through formal collection routes, as well as other, or non-official routes.

- **Households were responsible for the majority (80%) of the WEEE thrown away in London – equivalent to 30kg per household**

  Households were estimated to be responsible for 80% of the WEEE generated and disposed of in 2024 (106,900 thousand tonnes). This is equivalent to 30kg per household, or the weight of an undercounter fridge.[63] Table 3 outlines the top three categories, by weight. The dominance of these three categories is unsurprising, as they also represent the largest categories of new EEE placed on the market by weight.

- **London's businesses and institutions were responsible for 20% of the WEEE thrown away in London – almost 52 kg per business on average**

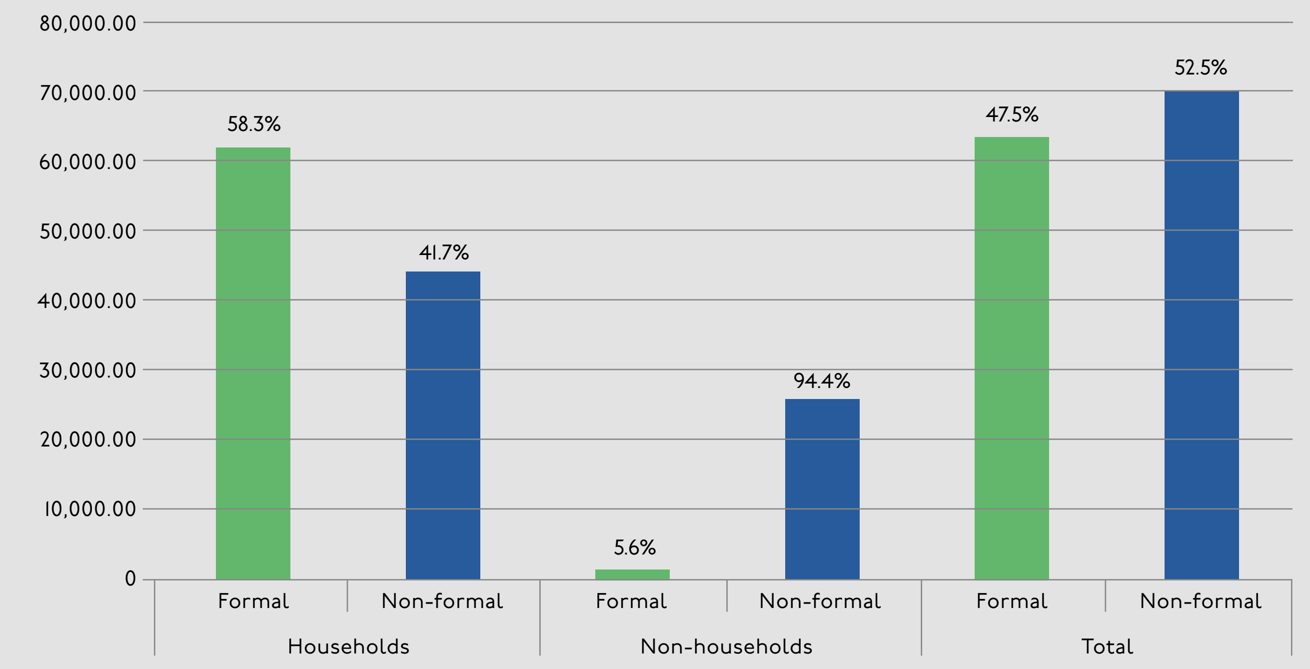
  In 2024, 27,600 tonnes of waste EEE were disposed of by London's businesses and institutions (non-households). This corresponds to 51.9 kg per registered business in the capital (equal to the weight of over 17 laptops). Table 4 outlines the top three categories thrown away by non-households. This also reflects the relative proportions of new EEE placed on market for non-households.

  As mentioned previously, this value represents only 55% of the EEE in non-households predicted to be coming to the end of its first life - a notable data gap that might suggest the management of EEE through other third-party entities, such as IT Asset Management & Destruction (ITAM/ITAD) firms.

Table 4: Top three WEEE categories disposed of by households and non-households in 2024 (waste tonnage)

Rank	Households		Non-households	
1	Large household appliances	24,300 t (23%)	IT and telecoms equipment	9,400 t (34%)
2	Cooling appliances containing refrigerants	19,100 t (18%)	Lighting equipment	4,400 t (16%)
3	IT and telecoms equipment	16,000 t (15%)	Small household appliances	2,800 t (10%)

Figure 7: WEEE collection and disposal pathway by source (tonnes)



3.2.7. Formal collection

- **47.5% of the WEEE thrown away in London was disposed of through formal collection routes**

  In 2024, approximately 63,800 tonnes of WEEE were collected via formal collection routes. The majority (97.6%) of EEE disposed via formal collection routes originated from households, with non-households responsible for the remaining 2.4%.

  As such, the formal collection rate of WEEE in London (which is the percentage of WEEE formally collated relative to the estimated total generated and disposed) was 47.5%. When looking exclusively at households, this formal collection rate rises to 58.3%, as a result of the high share of non-household WEEE estimated to be disposed of in other/ non-formal channels.

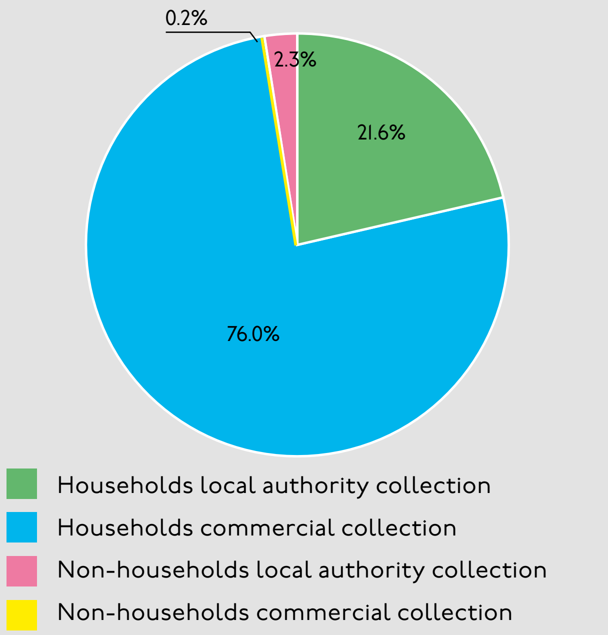
- **Commercial collection systems (like retailer takeback schemes) were responsible for the majority (78.3%) of the formally collected WEEE**

  Of the total WEEE formally collected, local authority collection pathways such as kerbside collection and depositing at HWRCs collected 21.7% (13,900 tonnes). Commercial collection routes, such as retail takeback schemes, were responsible for the collection of 78.3% (50,000 tonnes). A larger quantity of bulkier items, such as cooling appliances with refrigerants, and large domestic appliances, were collected via this route which is often provided as a service by retailers with the purchase of a new item.

- **London's formal collection rate is estimated to be higher than the UK average**

  When comparing the quantities of EEE that are estimated to be reaching the end of their first life in the capital, the share that is formally collected falls to 39.0%. This is higher than the estimated rate for the UK (30.4%), reported by Global E-waste monitor in 2022.[64] This value for London suggests that there is a large share of EEE that is not accounted for via disposal routes, and may remain in households, or go through their second life through repair.

Figure 8: Formal collection by type and source (tonnes)



3.2.8. Other / Non-official collection

- **Over half of the WEEE thrown away in London (52.3%) ends up in non-formal collection routes**

  Of the total quantities of WEEE that were generated and disposed of in London in 2024, approximately 52.3% (70,700 tonnes) were disposed of through non-official routes, including residual waste and co-mingled scrap metal recycling as well as illegal routes like fly tipping and illegal exports.

  Due to the presence of hazardous materials and components within WEEE, improper disposal can present risks including to health and safety as well as to the environment through chemical leakage. In particular, instances of fires in waste collection machinery and facilities caused by batteries and accumulators have reportedly increased by 71% in the UK between 2022 and 2024.[65]

- **In 2024, the average Londoner improperly threw away 5.0 kg of WEEE**

  London's households were responsible for the improper disposal of 44,600 tonnes of WEEE. This is equivalent to each Londoner, on average, improperly throwing away 5.0 kg of WEEE each year – equivalent to the weight of a laptop plus four mobile phones[66]. Complementary research into the behaviours and attitudes to e-waste of UK households indicates that a lack of awareness of correct WEEE disposal routes is a leading cause of people throwing away items in residual waste.[67]

Residual waste:

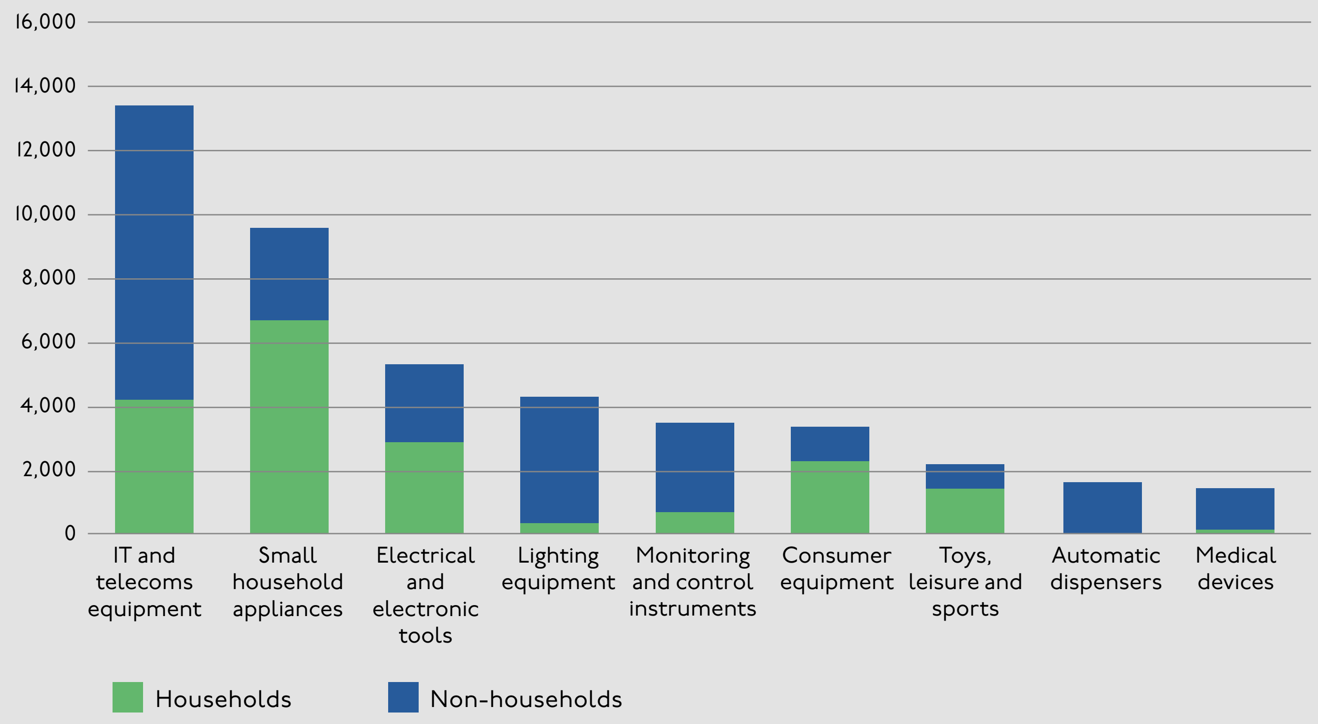
- **The majority of items thrown away in residual waste are small in size, being able to fit in a residual bin**

  Approximately 44,300 tonnes of WEEE were thrown away within mixed residual waste in 2024, which represented 62.3% of the WEEE disposed of in non-official routes. Due to the large variation in the size of EEE, this waste stream is generally made up of smaller items that fit within a residual bin, such as IT and telecoms equipment (30.3%), and small domestic appliances (e.g. toasters, kettles) (21.5%).

- **London's businesses and institutions were responsible for an estimated 58% of WEEE disposed of in residual bins**

  Non-households represented 58.3% of the WEEE thrown away in residual bins, with IT and telecoms representing the largest proportion. This large proportion follows other studies,[68] and indicates the need to further explore the drivers behind the use of this route by non-households, such as inadequate collection coverage, regulation or awareness of formal disposal routes.

Figure 9: Breakdown of WEEE in residual waste, by source



Co-mingled scrap metal recycling:

- **One fifth (20%) of the WEEE thrown away in non-official routes was recycled as part of co-mingled scrap**

  In London, over 15,300 tonnes of WEEE was estimated to be disposed of and managed as mixed material through scrap recycling. Ultimately, WEEE is lost to the formal collection and reporting system as it is contained within waste reported as mixed metal. This is often collected by individual waste processors not authorised under the UK WEEE Regulations as an authorised approved treatment facility (AATF). It represents a leakage of materials from the system, in particular critical raw minerals, and can pose health and environmental risks.

Fly tipping waste:

- **5% of the WEEE thrown away in non-official routes was fly tipped, resulting in additional clean-up costs**

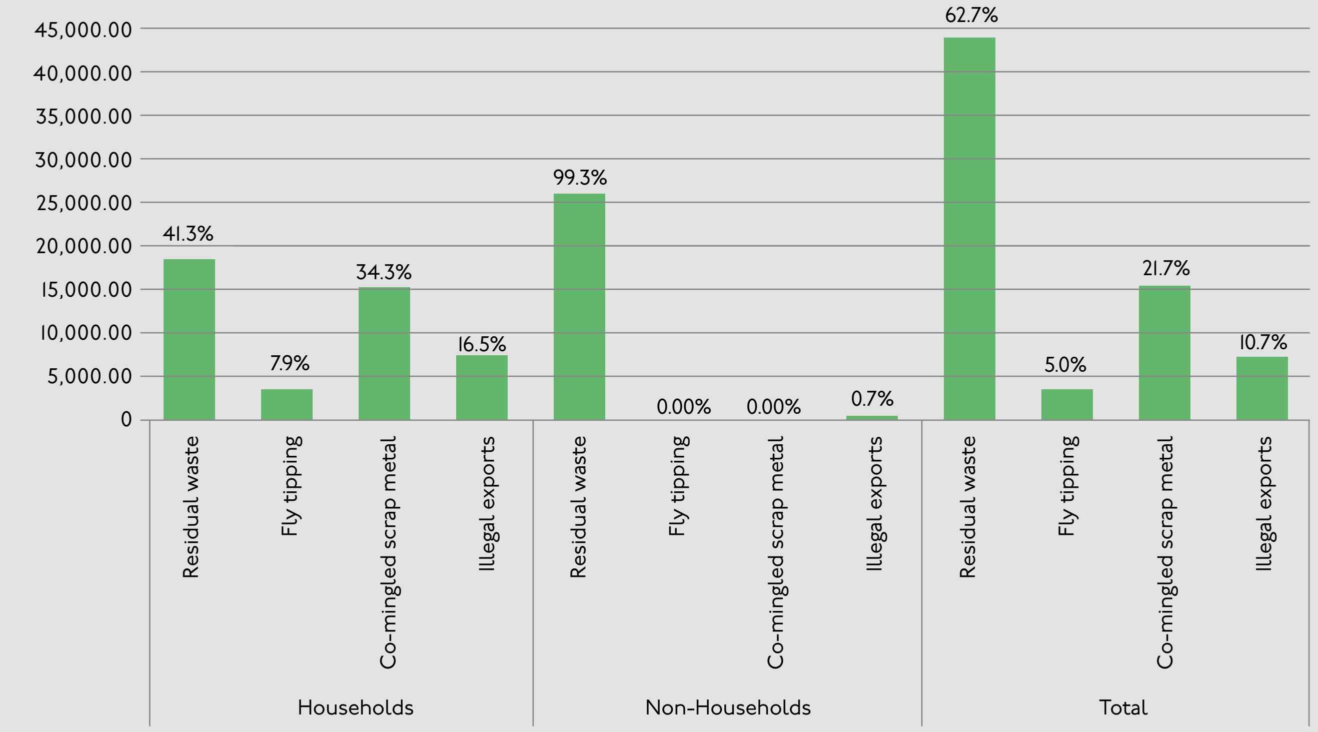
  In 2024, an estimated 3,500 tonnes of WEEE were fly tipped – or illegally dumped. This represented 5.0% of the WEEE disposed in non-official routes. Fly tipping is an additional burden for local waste authorities who are required to coordinate its safe removal, as well as a risk to health, safety and the environment.

Illegal exports:

- **WEEE produced in London is illegally exported as 'used' products to be processed outside of the UK, causing health and environmental issues**

  Under the Basel Convention, it is prohibited to export non-functioning e-waste outside of the UK to non-OECD countries. Nevertheless, it is estimated that about 7,540 tonnes ended up being illegally exported in 2024, the equivalent of 0.8 kg per person (approximately the weight of two mobile phones). This often occurs by WEEE being disguised as 'used' products for resale. The illegal shipment of WEEE is an increasingly recognised challenge, prevalent across other EU and OECD countries, and is not exclusive to London.[69] It presents an important point within the system to prevent leakage and mitigate environmental and health risks in other countries.

Figure 10: Non-official disposal route by source (tonnes)



3.2.9. End of life

Following the collection of WEEE, either through formal or non-official routes, WEEE is processed and managed via various treatment approaches. While this research focuses on the WEEE that is generated within London, some of the WEEE is transported to facilities outside of the city boundaries for processing.

Recovery and recycling at authorised approved treatment facilities

- **23% of the WEEE thrown away in 2024 was processed for recycling in an approved treatment facility, all of which was collected by formal collection routes**

  Almost 30,800 tonnes of the WEEE that was formally collected in 2024 was processed through an authorised approved treatment facility (AATF). In order to operate and maintain permits, AATFs are required to demonstrate that stated recovery rates per WEEE category are being met.[70] Recycling rates for WEEE categories range between 80% for categories like large domestic appliances, to 55% for lighting equipment.[71]

- **Increasing the quantities of WEEE components to recycle as a possible source of critical raw minerals, is dependent on increasing the formal collection rate**

  Processing of WEEE varies across categories and includes removing of refrigerant gases, separating circuit boards, and shredding and separating into different material fractions. As mentioned previously, WEEE contains a wide assemblage of valuable and critical raw minerals (CRMs), demand for which is increasing.[72] The recovery rates of such CRMs can vary. Their relatively small weight and complex assembly within WEEE can present challenges for cost-effective recovery; but, as noted by the UK's Critical Minerals Strategy, WEEE represents a potentially valuable source of critical raw materials, particularly in the context of volatile global supply chains.[73]

  Recycling rates are linked to the quantities of WEEE that are formally collected. Therefore, it is important to increase formal collection rates to increase recovery and recycling of WEEE. There are however persistent challenges in the recovery and recycling of WEEE, particularly for some materials. For example, plastic poses a risk of the presence of Persistent Organic Pollutants (POPs), which limits the ability to recycle this material and means it has to be incinerated.[74]

Other recycling

- **11.4% of the WEEE thrown away in London was recycled outside of an authorised approved treatment facility, largely as co-mingled scrap metal**

  While the majority of the WEEE that is recycled was processed in AATFs, approximately, 18,400 tonnes of WEEE are estimated to have been processed through recycling routes outside of AATFs in 2024. This is thought to include co-mingled scrap metal recycling, as well as recycling as part of co-mingled residual waste management systems. While the recovery of materials did occur via these two routes, it is important to state that these routes pose health and environmental risks in their processing.

Incineration

- **32.3% of the WEEE thrown away in London was incinerated, representing a loss of value of items and materials**

  In total, almost 43,500 tonnes of WEEE were processed via incineration (both with and without energy recovery) in 2024. This corresponds to 32.3% of the WEEE generated and disposed of in London that year. The majority of this incinerated WEEE came through non-official collection routes (including residual waste and fly tipped WEEE). Illustratively, over 60% of the WEEE collected through non-official routes (such as residual and fly tipping) was processed via incineration.

  A small fraction of incinerated WEEE (almost 80 tonnes) originated however from formal collection and disposal routes, with the purpose of (for example) destroying hazardous materials, such as plastics containing POPs.

Landfill

- **1% of the WEEE thrown away in London ended up in landfill in 2024**

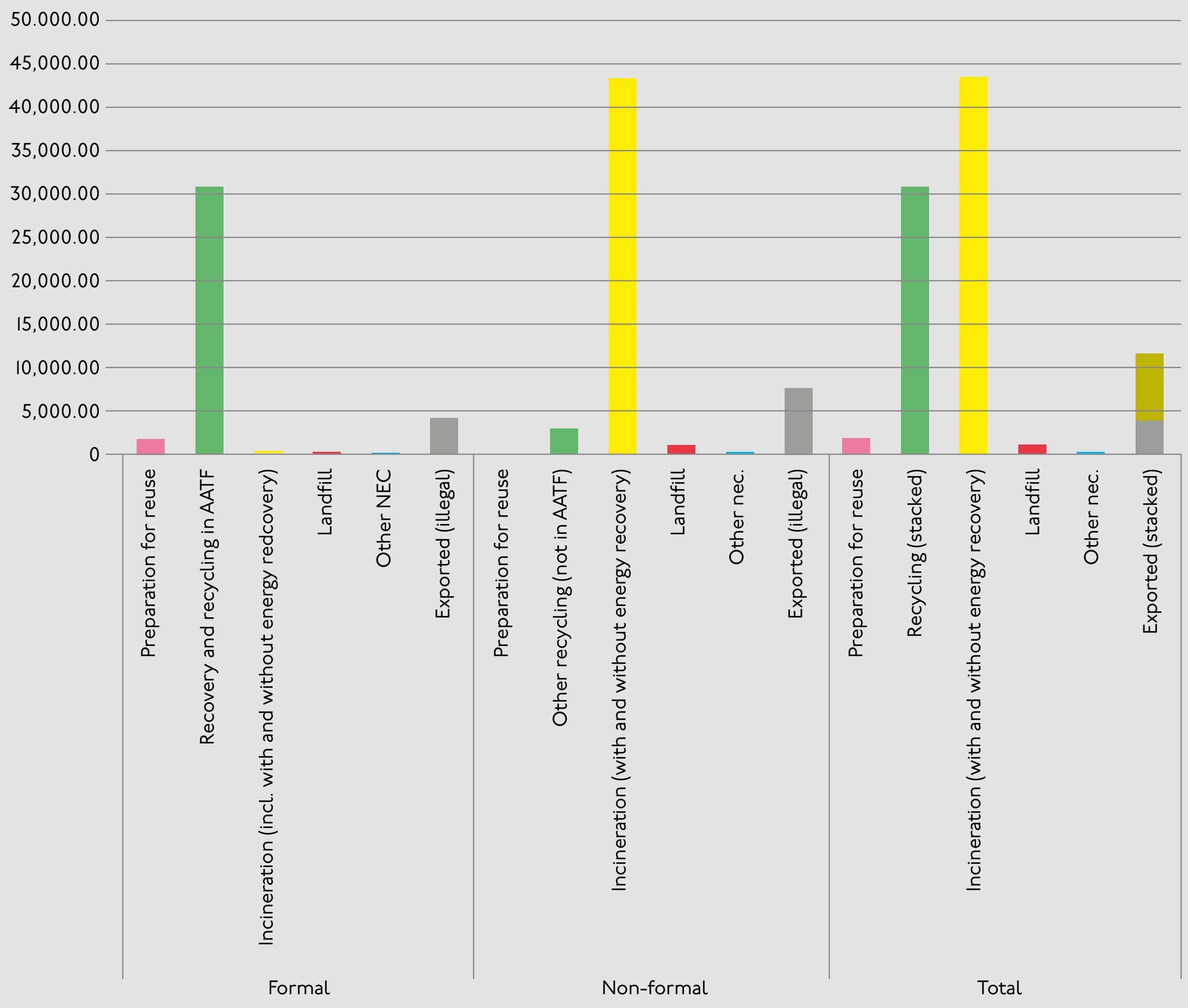
  1,070 tonnes of the WEEE generated in London was sent to landfill in 2024 and represented a loss of value and risk to the environment through the leaching of chemicals into the ground. Like incineration, the majority of this landfilled WEEE originated from non-official collection routes (e.g. residual waste). Increasing formal collection routes therefore presents an important opportunity to reduce landfill rates and subsequent environmental damage.

Legal exports

- **3.8% of WEEE thrown away in London was exported legally to be processed outside of the UK**

  An estimated 4,100 tonnes of WEEE were legally exported outside of the UK in 2024. This included second-hand products in working condition, or exported for recovery. It is not permitted to export WEEE for disposal, and exports for recovery must be carried out by an Approved Exporter (AE).[75]

Figure 11: End of life fate per collection and disposal route (tonnes)



3.3. In focus: carbon emissions in London's EEE supply chain, excluding use

- **The production and disposal of household EEE in London in 2024 generated 5.90 million tonnes of greenhouse gas emissions, the same as powering almost 2.1 million households for a year**

  In 2024 London's greenhouse gas emissions resulting from the production and disposal of the EEE used in London (not including use phase) totalled 8.41 million tonnes CO_2e. These household emissions equate to approximately 0.65 tonnes CO_2e. per person and is the equivalent to the emissions related to the annual electricity and gas consumption of 2.1 million UK homes.

  Scaled to include both households and non-household EEE increases this total to 9.10 million tonnes CO_2e. and is the equivalent to the emissions related to the annual electricity and gas consumption of an addition 1.1 million UK homes, to a total of 3.2 million homes.[76]

- **5.42 million tonnes of greenhouse gas emissions are produced before the items for households reach the city – equivalent to putting 3.3 million petrol cars on the road for a year**

  Upstream (cradle-to-consumer) embodied emissions, including material production, manufacturing, transportation and distribution dominate, representing c.92% of the emissions associated with EEE (excluding use phase). This is equivalent to the annual tailpipe emissions of 3.3 million petrol cars.[77] When taking non-households into account, it is estimated that this value would increase to 7.7 million tonnes CO_2e. This highlights the influence of a wide range of stakeholders to tackle this hotspot, including product manufacturers who could design resource-efficient, durable and repairable products to reduce the environmental footprint of EEE. Within London there is an opportunity to tackle it with initiatives to promote the reuse and repair of EEE in order to reduce the demand for new products, and thereby their associated carbon impact.

- **Five products are responsible for generating over 40% of household EEE-associated emissions in 2024**

  The emissions associated with London's EEE supply chain are dominated by several key products and categories. The top five most carbon intensive products represent 41.9% of the associated carbon emissions modelled here. These five products represented 29.8% of new products placed on the market in 2024, making these products emissions-intensive, despite their relatively low weight. Importantly, this research does not consider the use phase and so pinpoints only those products with the greatest up- and down-stream impacts. As such, these products which should be prioritised in terms of extending their lives beyond first use.

Table 5: Top 5 UNU products categories by total emissions (tonnes CO_2e.)

	UNU product category and code		Unit	% of Emissions: Total Emissions (tonnes CO_2e)	% of new POM (tonnes)
	702	Game consoles	kg CO_2e	9.8%	1.3%
	301	Small IT equipment (incl. routers, external drives)	kg CO_2e	9.3%	0.9%
	408	Flat display panel TVs (LCD, LED, Plasma)	kg CO_2e	8.0%	3.5%
	002	Photovoltaic panels	kg CO_2e	7.6%	10.5%
	104	Washing machines	kg CO_2e	7.0%	13.7%

- **Repair and remanufacture represent up to c.5.8% of the associated emissions of electrical and electronic equipment, caused by the emissions embodied within replacement parts**

Extending the lifespan of electrical and electronic equipment through repair through repair and refurbishment can require replacing broken parts and components, such as batteries, motors, or buttons.

In a similar way to the production of new electrical equipment, new components can produce additional greenhouse gas emissions caused by the extraction of raw materials, manufacturing processes and transport. In London in 2024, the repair and remanufacture of household electrical equipment was estimated to generate 0.34 million tonnes of CO_2e. (c5.8% of the emissions associated with households).

It is important to note that not all repair or refurbishment requires the replacement of components to extend an item's lifespan. As such, this represents a conservative estimate. Nevertheless, when repairing and remanufacturing an item, it is important to consider the types and number of new components that are required.

Modelled levers for action and their potential impacts

4. Modelled levers for action and their potential impacts

This section presents three levers to reduce the footprint of London's electricals and electronics supply chain.

The analysis of London's EEE supply chain provides a system-level overview of the volumes of EEE that flow through London each year, and the estimated greenhouse gas emissions associated with this supply chain. This overview has helped identify levers which could reduce London's carbon footprint and support London's ambitions to become a zero-waste and net zero-carbon emission city. These levers were refined through a stakeholder workshop and discussion with the project advisory group and are intended to serve as examples of the potential impact of a more circular system.

The purpose of the following section is to provide a quantified estimate of the potential emissions reduction of taking concerted effort on each opportunity area. It is not intended or possible to quantify the potential impacts of a specific policy intervention.

Focus of the levers: Households

Research and conversations with industry stakeholders highlighted that EEE is a very mixed group of products, used in many different ways across both household and non-household settings. Because of this diversity, each of the 14 EEE categories presents its own set of challenges and opportunities when it comes to designing for and delivering a more circular economy.

The opportunities and pathways for reuse, repair and collection are anticipated to differ between households and non-households due to their unique dynamics. As a result of data limitations, it is challenging within the scope of this research to model both households and non-households – and so, because of their significance in London's EEE system, households have been prioritised and selected for the following section: household consumption represented 79% of the new EEE placed on market in 2024, and households are responsible for 80% of the WEEE disposed of in London.

Non-households however present an interesting area of future exploration and research. While the levers overleaf may also apply to non-households, they may require different approaches which have not been explored here.

Three key levers were selected to be explored further:

1. **Increase the reuse of household EEE to displace new purchases**
2. **Increase the repair of household EEE to extend its lifespan**
3. **Increase formal collection rates for household WEEE.**

For each of the levers, scenarios were developed which quantify the potential of each lever to reduce the carbon emissions associated with London's EEE supply chain. Two scenarios have been developed for each lever:

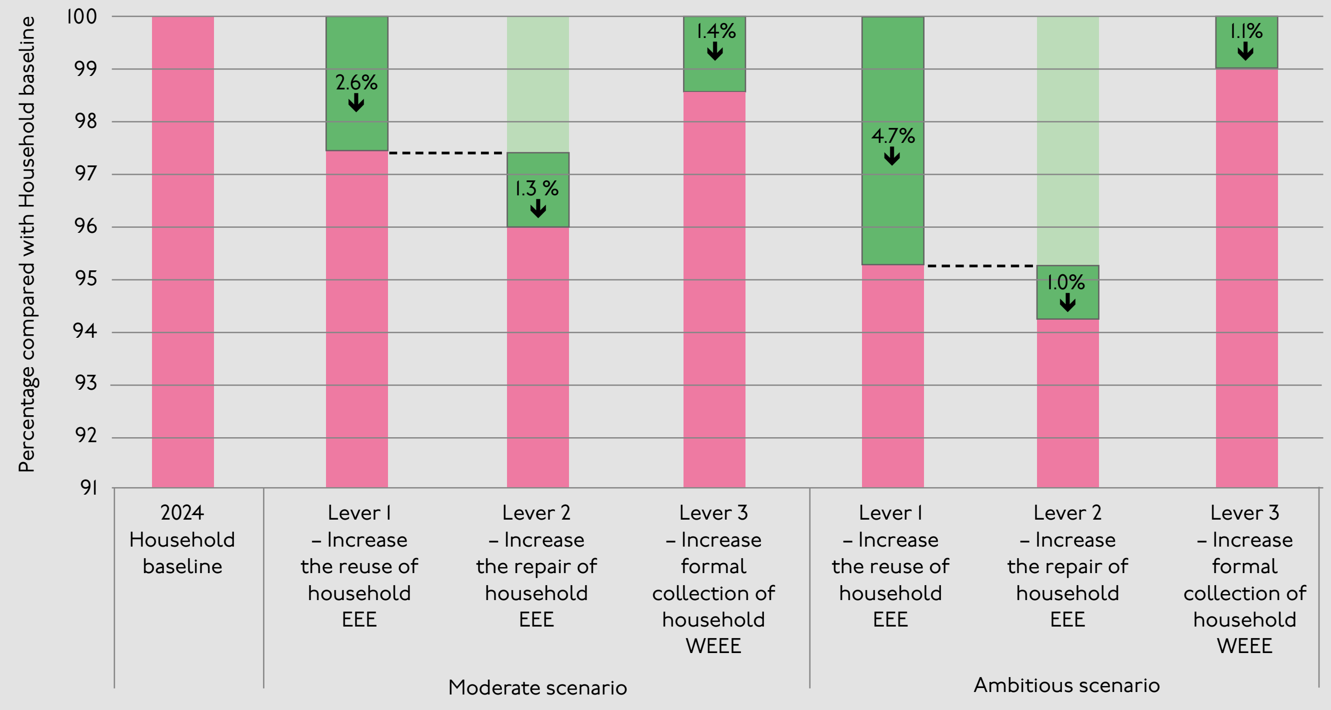
- **Moderate scenario:** represents a scenario whereby concerted progress has been made on each of the levers.
- **Ambitious scenario:** represents a scenario whereby more ambitious actions have led to much greater progress on each of the levers.

The scenario inputs and results for both the 'moderate' and 'ambitious' scenarios build on the 2024 material flow and emissions baseline for London's EEE system, as presented in section 3 of this report. The ambition level of each scenario has been developed to align with existing objectives and targets where possible, although it should be noted that there are no existing targets pertaining to reuse and repair of EEE in the UK at present. Further detail on the scenarios developed for each lever are presented in the following sections (4.1-4.3).

Figure 12 provides a summary of the estimated impact each lever might have on the carbon emissions associated with the production and disposal of WEEE in London across the scenarios when compared to the 2024 baseline for households. While the impact of each lever is modelled separately, they are nevertheless likely to be mutually supportive and additive. For example, taken together in an ambitious scenario, Lever 1 and Lever 2 could generate a combined impact of a c.5.7% reduction in emissions when compared with the 2024 baseline. This reduction of greenhouse gas emissions is the equivalent to cutting the annual gas and electricity emissions of 120,000 UK homes.[78]

Further detail on each lever and its potential carbon reduction is provided in sections 4.1, 4.2, and 4.3 of this report.

Figure 12: Estimated carbon impact of each lever against 2024 household emissions baseline



NB: Levers 1 and 2 illustrate a combined and additive impact.
Lever 3 has been modelled independently.

It should be noted, that for lever 2 and lever 3 the estimated emissions savings across both scenarios does not change substantially. This is caused by a balance in emissions intensity of specific activities such as transitioning from incineration to recycling. However, it is noted that avoided emissions for recycling and repair are not included in this study. If these benefits were fully captured, for example, by increasing recycled content during production, the potential emissions reduction of the ambitious scenario would be expected to increase. The potential emissions reduction of the repair lever is also influenced by the extent of new parts and components that are required to fix these items. If the amount of replacement parts and components were minimised, or were sourced from old equipment, this could result in even greater carbon savings. Nevertheless, this highlights that it is encouraging that a more moderate amount of effort can generate emissions savings.

4.1. Lever 1 – increase the reuse of household EEE to displace new purchases

The majority (92%) of the emissions associated with London's EEE supply chain for households are 'embodied' within the product before it even enters the city. This means that they are caused by the energy consumed through the material extraction, manufacturing and transportation stages of a product's life cycle. Londoners are however throwing away 16,200 tonnes of EEE annually which is in a directly reusable condition,[79] which is around 15% of the total amount of EEE that they dispose of (by weight). This means that not only is the financial and use value of these products being wasted – so too are the emissions that are embodied within them.

Other studies suggest there are about 10 items in long-term storage in an average UK home.[80] Therefore, as we do not quantify the amount of EEE in long-term storage, the estimated quantity of EEE in reusable condition that is used in this lever is likely an underestimate of the total volumes of EEE in reusable condition across London's households.

Given the quantities of new EEE consumed by London's households each year, this lever explores the potential of increasing the reuse of household EEE throughout London and increase access to second-hand EEE, helping people avoid the need to buy new items. This can both keep items in circulation for longer and (re)distribute them for as long as possible, while avoiding the need to produce new items in the first place (thereby avoiding their associated embodied emissions). This relationship between an increase in reuse rate of EEE and reduction in the consumption of new EEE is referred to as the displacement rate.

In Table 6, we analyse the potential impact of diverting a portion of the EEE that is currently disposed of by households in a directly reusable condition into the second-hand market for reuse. The ambitious scenario quantifies the impact of capturing all of these items, while the moderate scenario explores the potential impact of only half of this reusable EEE being captured and diverted to reuse.

Moderate scenario:

Pursuing this lever in London's households could result in a 2.6% reduction in the emissions associated with household EEE (excluding use) in a moderate scenario. The majority of these emissions savings originate from the avoidance of the production of new EEE, thereby avoiding the emissions generated in their production. In terms of waste tonnages, the moderate scenario would enable the reuse of an estimated 8,000 tonnes of EEE, and divert them away from waste.

Ambitious scenario:

Under an ambitious scenario, this impact is estimated to increase to a 4.7% reduction of the carbon emissions associated with the production and disposal of household EEE (excluding use). What's more, 16,200 tonnes of EEE would be diverted from the waste stream to be reused.

But EEE covers a wide range of products, with different reuse pathways. Some reuse pathways, such as selling items through online consumer marketplaces (e.g. Gumtree, eBay, Olio, etc.) allow people to earn money from their unwanted items. Others, such as being prepared for reuse after it is deposited in a collection system (typically by local authorities), are based on a 'donation' system, where the item is then passed on for free. Since some reuse pathways offer a financial return while others do not, certain types of products may be more likely to end up being managed via specific pathways: for example, higher-value items (like digital cameras) are more likely to be sold through consumer marketplaces as there is a financial incentive, while lower-value items are more likely to be donated.

It is therefore important, if the full potential of EEE is to be realised, to take a system-wide perspective that takes into account different types of EEE disposed of across various pathways, and people's motivations for using these different pathways.

Although not included within the scope of this lever, promoting the reuse of EEE across non-households (businesses and institutions) would likely also result in a displacement of emissions associated with avoided new purchases. Actions by these organisations such as introducing procurement policies which prioritise refurbished EEE – particularly for IT and telecoms equipment (phones and laptops) – could help to further reduce London's EEE footprint.

Table 6: Lever 1 scenario definition

Scenario	Description	Reused EEE as a share of households POM, tonnes	Change in emissions from household EEE supply chain, CO_2e.
Baseline	-	14.2%	-
Moderate scenario	Capture half of the EEE disposed of in reusable condition	18.2%	↓ **2.6%** reduction
Ambitious scenario	Capture all EEE disposed of in reusable condition	22.2%	↓ **4.7%** reduction

Key assumptions:

- Applying a displacement rate of 1:1.[81]
- Using reusable shares from WRAP (2011) - applied to all WEEE formally collected. Product reuse rates are used from WRAP for the categories mentioned. For the other categories, due to limited data, the average rate is used.[82]
- Reuse is assumed to occur equally across the three defined reuse pathways: one-third in C2C reuse, one-third in refurbishment/remanufacture, and one-third in end-of-life preparation for reuse.
- Reuse is not considered for EEE in long term storage in households.
- The WEEE collected under reg. 45 (takeback schemes) has a comparable share of directly reusable EEE that is not currently reused.

Local leader

Groundwork's ReWork programme

ReWork, operated by Groundwork London in partnership with the Western Riverside Waste Authority, is one of the UK's busiest appliance refurbishment facilities, extending the life of white goods through repair and reuse.

Since it began in 2012, the programme has refurbished over 58,000 appliances and diverted significant material from landfill, avoiding an estimated 43,000 tonnes of CO_2 emissions through circular practices.

Appliances unsuitable for full repair are harvested for parts, supporting wider repair activity across London. ReWork also provides accredited technical training to Londoners facing barriers to employment, strengthening local green skills pathways.[83]

Global inspiration

France WEEE Reuse Target

From 2023, producers in France must ensure that 2% of electrical and electronic equipment (EEE) placed on the market in the previous year is reused or prepared for reuse. Meeting this target is estimated to avoid 46,800 tonnes of WEEE, avoiding around 187,000 tonnes of CO_2 emissions—equivalent to removing 89,000 cars from the road and nearly matching the annual carbon footprint of 28,000 EU residents. What's more, compliance with the target is estimated to support the creation of 7,000–16,000 additional jobs in reuse activities.[84]

4.2. Lever 2 – increase the repair of household EEE to extend its lifespan

Since 2021 the UK has adopted 'Right to Repair' regulations to support the extension of product lifespans and reduce WEEE. Repair rates however are still relatively low. In 2024, Londoners repaired over an estimated 6,000 tonnes of household EEE, but threw away twice as much that could have been repaired (almost 11,200 tonnes).

In a similar way to lever 1 for reuse, this figure of 11,200 tonnes is likely to be an underestimate, since other research has indicated that each household could be stockpiling around 10 items of EEE in long-term storage.[85] Some of these items may be able to have a second-life following repair.

The damage and failure of EEE leads to new purchases to replace the broken item. Across the industry, product lifespans and replacement cycles are observed to be consistently shorter than their technical or optimal lifespans.[86 87] This can lead to people buying new products at a faster rate than should be necessary to replace broken items, resulting in higher costs for the consumer and greater carbon emissions for the planet; and it represents a real opportunity to reduce both the environmental and financial cost of producing new EEE by increasing the amount of EEE that gets repaired across London.

For this lever, we quantify the scale of repair that could be realised in London, but we recognise that the extent of repair can vary across items, and some repair can be prohibitively expensive. The scenarios for this lever are therefore based on variations in the extent of repair required across various product categories.[88]

Moderate scenario:

The moderate scenario for this lever is based on items that are disposed of in a condition that requires 'slight repair', considered as: slightly damaged, chipped, scratched or casing cracked and would benefit from minor repair work, but is complete and capable of fulfilling the function it was designed for.[89]

This scenario suggests that increasing repair across London's households could increase repair rates for household EEE reaching the end of its first life from 5.3% in the baseline to 10.6%, resulting in a reduction of c.1.3% of the emissions associated with London's household EEE (excluding use).

Ambitious scenario:

The ambitious scenario considers both items requiring 'slight repair' and those in need of more 'major repair', considered as: parts will be required to repair the item as not fully functional, but repair would not be prohibitively expensive.[90]

Modelling the potential impact of this scenario shows that a reduction of c.1.0% of the emissions associated with London's household EEE (excluding use) could be achieved as a result of an increase in repair rates across London's household from the 5.3% baseline to 15.1%. It is noticeable that there is only a small change between the moderate and ambitious scenarios. The overall carbon estimate is influenced by the extent of new parts and components that are required to fix these items. In this ambitious scenario, as more items are being sent to repair, a greater volume of replacement items is assumed to be required. This serves to highlight the potentially significant greenhouse gas emissions associated with new replacement components, such as batteries.

In a similar way to Lever 1, the majority of the emissions reduction for both these scenarios is associated with the displacement of new purchases offset by the repair of existing items. While specific displacement rates will vary for each product, it is assumed here that the displacement rate for repaired EEE is lower than reused EEE. In other words, repairing EEE is less likely to avoid a purchase of EEE than a household obtaining a second-hand item. This lower displacement rate ultimately reduces the estimated carbon impact of this lever.

Other studies have also indicated that "with very few exceptions, it is always better for the environment to have faulty home appliances repaired and to keep them in service for as long as possible"[91] due to the energy and resources required for the production of new products. Nevertheless, as this research highlights, the embodied carbon of new components and the end-of-life treatment of old parts is an important consideration in the overall impact of repair.

Table 7: Lever 2 scenario definition

Scenario	Description	Repair as a share of households EEE at the end of its first life, tonnes	Change in emissions from household EEE supply chain, CO_2e.
Baseline	-	5.3%	-
Moderate scenario	Repair the WEEE that is disposed of in need of slight repair	10.6%	↓ **1.3%** reduction
Ambitious scenario	Repair the WEEE that is disposed of in need of slight and major repair	15.1%	↓ **1.0%** reduction

Key assumptions:

- Applying a displacement rate of 2:1.[92]
- Using repairable shares from WRAP (2011) - applied to all WEEE formally collected. Product reuse rates are used from WRAP for the categories mentioned. For the other categories, due to limited data, the average rate is used.[93]
- A comparable share of repairable items is considered for EEE within informal waste streams with a discount factor of 50% being applied.[94]
- Repair is assumed to occur equally across the three defined repair pathways: one-third through community repair; one-third through producer repair; one-third through high street repair.
- Repairability is not considered for EEE in long-term storage in households.

Local leader

North London Repair Voucher Scheme

Launched in April 2025, the North London Repair Voucher Scheme offered residents 50% off electrical repairs (up to £50) to reduce waste and stimulate local repair markets. Funded by the North London Waste Authority and delivered by The Restart Project, ReLondon and FixFirst, the scheme targets cost barriers—one of the main reasons residents replace rather than repair.

To date, 4,000 residents across north London have applied for a voucher to fix their household electricals and electronics. Most common items fixed include smartphones (42%), vacuums (23%), laptops (15%), tablets (5%), and digital cameras (3%).

This scheme has helped to build a culture of repair, as 85% of voucher beneficiaries report that they are very likely to consider repair the next time something breaks; and 63% of respondents report that they plan to encourage others to repair. This will likely have local economic benefits as 76% of respondents note that they are also very likely to use the repair shop they took their item to again.[95]

Global inspiration

Vienna Reparaturbon Repair Voucher Scheme

Vienna's Reparaturbon scheme incentivised residents to repair rather than replace consumer goods by subsidising 50% of repair costs, capped at €100, deducted directly from invoices to minimise administrative burden.

The programme partnered with an established repair network, enabling accessible, low-cost services across the city. It proved highly effective: over 35,000 items were repaired, contributing to resource conservation and an estimated 850 tonnes of CO_2 savings. By making repairs competitively priced and convenient, Vienna demonstrated how targeted financial incentives can stimulate circular behaviours, support local repair economies, and reduce material throughput.[96]

4.3 Lever 3 – increase formal collection rates for household WEEE

In the UK, WEEE collection targets are outlined in the WEEE Regulations. The UK's collection rate sets a target for compliance schemes to meet. The regulation specifies collection tonnages for each compliance scheme based on their relative market share.[97]

The recovery and recycling rate of WEEE is linked to the formal collection rate – that is, the more WEEE that is collected through formal routes, the more WEEE is being properly recovered and recycled (for further detail, see section 3.2). Boosting formal collections therefore presents an important lever to capture the value and materials (such as critical raw materials) within WEEE, while reducing the health and environmental harm caused by improper disposal.

For the purposes of this study, this lever aligns with the EU WEEE Directive 'WEEE generated' collection target, which is based on the share of formally collected WEEE as a share of total WEEE generated in the same year.[98] The EU WEEE Directive outlines a 'WEEE generated' collection target of 85% highlighted in section 3.2, in 2024, the collection rate for WEEE generated by London households was 58.3%.

The moderate scenario is based on the current best practice as currently reported in the EU for a 'WEEE generated' collection target, which in 2024 was held by Estonia.[99] The ambitious scenario is based on the 85% 'WEEE generated' collection target as established in the EU WEEE Directive.[100]

Moderate scenario:

In a moderate scenario, London could divert an additional 9,900 tonnes of WEEE away from non-official disposal routes. This corresponds to an addition 1.1 kg per person. Although not quantified in this report, this diversion of WEEE to formal collection and disposal routes is likely to reduce the risks to health and the environment caused by improper disposal.

In terms of the impact on emissions, the change in emissions is modest, estimating a c.1.4% in the emissions associated with household EEE.

Since much of the incineration of residual waste results in energy generation, processing WEEE through incinerating it with residual waste can be seen as helping to reduce the consumption of fossil fuel energy.

Ambitious scenario:

If London were to meet the ambitious formal collection target outlined in this scenario, an estimated additional 28,600 tonnes of WEEE could be diverted from non-official routes (approximately 3.1 kg per person). From an emissions perspective, an estimated c.1.1% change in the emissions associated with household EEE is estimated.

It is noted that the emissions reduction in the ambitious scenario is slightly lower than the moderate scenario. This is because in the current study, recycling diverts waste from incineration with energy recovery. Notably, the current model does not account for the avoided emissions from recycling i.e. benefits of recycled content in production are not accounted for. Initially, diverting from incineration to recycling creates a benefit since recycling is less energy intensive than incineration. However, at a certain inflection point, as recycling rates increase further, these savings are offset by the loss of energy recovery from displaced incineration. Furthermore, avoided emissions from the recycled materials are not included in the current model which also means the benefits of increased recycling are not fully credited. In other words, the initial gains of diverting waste to recycling are outpaced by loss in energy recovery from incineration, reaching a point where environmental benefits peak and then reduce. However, as the grid continued to decarbonise, this influence will likely reduce.

While the direct impact on emissions of increasing London's WEEE collection rate is modest, increasing formal collection of EEE before it becomes waste is an important enabler to increase its repair and reuse. Disposal and collection pathways can influence not just the volume of EEE collected but also their reuse and repairability. For example, items being stored in containers that are exposed to weather can irreparably damage items, which otherwise may have been suitable for reuse.[101]

Table 8: Lever 3 scenario definition and results

Scenario	Collection target	WEEE collected via formal collection, tonnes	Change in emissions from household EEE supply chain, tonnes CO_2e.
Baseline	58.3%	62,300	-
Moderate scenario	67.5%	72,190	↓ **1.4%** reduction
Ambitious scenario	85%	90,890	↓ **1.1%** reduction

Key assumptions:

- WEEE generated is based on the estimated EEE coming to the end of life, subtracting the quantities that are sent for repair and remanufacture, and as such are not disposed of as WEEE.
- Increase in formal collection routes is proportionately distributed across local authority and commercial routes.
- Decrease is proportionately distributed across each non-official WEEE collection route (residual waste, fly tipping, illegal export, co-mingled scrap metal recycling).

Local leader

Veolia e-waste collection points, Southwark

Veolia Southwark has expanded e-waste access by putting donation points in 12 libraries as well as at the local recycling centre, enabling residents to drop off unwanted electricals for reuse and recycling. Through a partnership with Community TechAid, devices such as laptops and phones are refurbished and redistributed to residents in need, while remaining items are responsibly recycled. This pilot collected 1,133 devices between July 2024 to July 2025, with 50 refurbished for reuse, demonstrating effective local collaboration in tackling WEEE. The initiative now runs permanently, supporting policy goals for increased reuse, reduced waste and improved material circularity in urban settings.[102]

Global inspiration

Recupel Pick-Up, Belgium

Recupel Pick-Up addresses gaps in collecting WEEE generated at offices, schools and similar institutions by providing a free, convenience-based service designed to capture business waste streams that are not effectively collected through municipal or retail channels.

Local reuse and repair centres collaborate with Recupel through contractual agreements, enabling re-use where appropriate before remaining materials are transferred to treatment operators[103].

Conclusions

05

5. Conclusions

This research has detailed the carbon and waste impacts of London's electrical and electronic Equipment (EEE) supply chain, and in particular underscores the significant impact that London's EEE generates outside of the city boundaries.

Approximately 0.65 tonnes CO_2e per person were produced in 2024 to meet London's household demand for new EEE, with 92% of these emissions occurring before these products even arrived in the city. At the same time, Londoners improperly disposed of an average 4.9kg of WEEE each in 2024, leading to both health and safety risks and environmental damage.

Encouragingly, the three key levers that have been modelled in this research can already be seen in action across London. What is needed now to achieve the potential impacts of the moderate or ambitious scenarios outlined above is collaboration to unlock their adoption at scale across the city. Each of the three levers could reduce London's household EEE carbon footprint. While not modelled, their benefits are expected to be transferrable to similar action in London's businesses and institutions:

- Diverting household EEE to reuse and repair could reduce households' carbon footprint associated with EEE (excluding use) by c.5.7% within the ambitious scenario. This is equivalent to cutting the annual gas and electricity emissions of 120,000 UK homes.[104]
- Increasing formal collection rates can enable increases in both reuse (Lever 1) and repair (Lever 2), as well as increase the quantities of EEE that are recycled, providing an important source of critical raw minerals.
- Taken together these measures could reduce the WEEE thrown away in the capital by 12,600 tonnes, the weight of approximately 1,000 double decker buses.

To drive action in London, collaboration across stakeholders is needed: bringing together local and national policymakers, businesses - including retailers and manufacturers - compliance schemes and research institutions. Establishing partnerships to provide incentives, initiatives and infrastructures will be important to create local systems that can collect, repair, redistribute and recycle electrical and electronic items – and capture its significant value.

The Mayor of London and London's boroughs, supported by ReLondon, are already taking action to accelerate the transition to a low carbon circular economy in the capital. For the past five years, the One World Living theme of London Councils' Climate Programme, has focused on helping London boroughs and their local communities reap the benefits from city-wide and local action that enables more circular lifestyles.

There is an opportunity now to establish and scale initiatives and partnerships to reduce the environmental and financial costs of e-waste and EEE consumption, to scope and scale thriving second-hand and EEE repair systems, and to improve formal collection and recycling of WEEE. In the process we can help alleviate some of the worst impacts of global supply chain issues, in particular around the extraction and supply of critical raw minerals. The levers in the report outline a clear pathway for London to become a leading low carbon circular city - one that makes the very best use of our available resources in a way that benefits people and the planet.

6. Appendices

6.1. Appendix 1 – Data sources and quality overview

Table 9: Data quality indication

Supply chain node	Main source(s) used
Production and imports	HMRC trade data
Placed on market	UK statistical data
EEE in use	Estimates from UK statistical data using established methodology.[105]
Reuse	Industry data and estimates
Repair	Industry data and estimates
WEEE generated and disposed (Formal collection)	WasteDataFlow
WEEE generated and disposed (Other / non-formal collection)	Estimates using WasteDataFlow
Exports	HMRC trade data
End of life management	WasteDataFlow
Emissions	EcoInvent, SimaPro, and secondary sources.

7. End notes

1 WRAP (2011) Realising the Reuse Value of Household WEEE: Summary Report Online.

2 Cornelis et al. (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024. Geneva/Bonn.

3 Cornelis et al. (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024

4 Food; Textiles, and; Packaging

5 Merseyside Recycling and Waste Authority (2024) Approved average weights of materials. Online: https://www.merseysidewda.gov.uk/wp-content/uploads/2024/01/Average-weights-of-materials.pdf

6 Merseyside Recycling and Waste Authority (2024) Approved average weights of materials. Online: https://www.merseysidewda.gov.uk/wp-content/uploads/2024/01/Average-weights-of-materials.pdf

7 Based on the average medium household electricity and gas usage, and DESNZ (2025) Conversion factors 2025. Online via: GOV.UK.

8 Excluding use phase.

9 ReLondon, London Councils, and the Greater London Authority (2024). A borough's guide to understanding and tackling consumption-based emissions. Online via London Councils website.

10 UNEP (2025) Emissions Gap Report 2025: Off Target – Continued Collective inaction puts Global Temperature Goal at Risk. Online via: Emissions Gap Report

11 WaterAid (2025) Water and Climate: Rising risk for urban populations. Online via: https://washmatters.wateraid.org/publications/rising-risks-urban-populations-water-climate-change

12 Cornelis et al. (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024. Geneva/Bonn.

13 ReLondon (2022) The Circular Economy at Work: The jobs and skills for London's low carbon future. Online via: ReLondon

14 Green Alliance (2021) Levelling up through circular economy jobs. Online via: Green Alliance Green Alliance

15 Element Energy (2022). Analysis of a Net Zero 2030 Target for Greater London Final report for Greater London Authority Online via: London government website

16 Greater London Authority (2018). London Environment Strategy. Online via: London government website

17 London Councils (n.d.). Boroughs' Climate Action. Online via: London Councils website

18 London Councils (n.d.). Boroughs' Climate Action. Online via: London Councils website

19 ReLondon (2017) London's Circular Economy Routemap. Online from: ReLondon website.

20 ReLondon & Circle Economy (2021) London's Food Footprint. Online via: ReLondon

21 ReLondon & UCL (2023) London's Fashion Footprint. Online.

22 ReLondon & Valpak (2024) London's Packaging Footprint. Online.

23 Cornelis et al. (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024. Geneva/Bonn.

24 Dalhammar et al. (2021) Increasing the Lifespan of Products: Policies and consumer perspectives. Lund University Publications. Online.https://lup.lub.lu.se/search/publication/297c1615-3e26-4d33-b267-8353874bc047

25 Cornelis et al. (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024. Geneva/Bonn.

26 Cornelis et al. (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024. Geneva/Bonn.

27 Cornelis et al. (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024. Geneva/Bonn.

28 Material Focus (2024) 1,200 battery fires in the waste system reported last year. Online via Material Focus

29 ReLondon (2017) London's Circular Economy Routemap. Online via: ReLondon website.

30 Secretariat of the Basel, Rotterdam and Stockholm Conventions (N.d.) Basel Convention: Overview. Online.

31 Ellen MacArthur Foundation (2019) Urban Products System Summary. Online. Circular economy in cities: Opportunity & benefit factsheets | Ellen MacArthur Foundation

32 European Commission (N.d.) Ecodesign for Sustainable Products Regulation: Overview. Online. Ecodesign for Sustainable Products Regulation - European Commission

33 DESNZ (2014) Regulations: Ecodesign of energy consuming products: Guidance. Online.

34 European Parliament (2016) Planned obsolescence: Exploring the issue. Online.

35 Conway, L. (2021) Right to Repair Regulations. House of Commons Library Research Briefing No.9302. Online.

36 UK Government (2018) Regulations: Waste Electrical and Electronic Equipment (WEEE). Online via GOV.UK

37 WRAP (2024) Divergencies between the UK WEEE & EU WEEE Extended Producer Responsibility (EPR) systems. Online via: WRAP.

38 WRAP (2024) Divergencies between the UK WEEE & EU WEEE Extended Producer Responsibility (EPR) systems. Online via: WRAP.

39 UK Government (2025) Vision 2035: Critical Minerals Strategy. Online via: GOV.UK

40 UK Government (2025) Vision 2035: Critical Minerals Strategy. Online via: GOV.UK

41 North London Waste Authority (2025) Demand for repair high as UK launches first repair voucher scheme. Online vial: NLWA

42 Forti V., Baldé C.P., Kuehr R. (2018). E-waste Statistics: Guidelines on Classifications, Reporting and Indicators, second edition. United Nations University, ViE – SCYCLE, Bonn, Germany.

43 Environment Agency (EA) (2023) Guidance: Report the amount of EEE you place on the market. Online via: GOV.UK

44 UK Government (2025) The Waste Electrical and Electronic Equipment (Amendment, etc.) Regulations 2025. Online via: Legislation.GOV.UK

45 UK Government (2025) WEEE: Collecting used and waste electrical and electronic equipment. Online via: GOV.UK

46 European Environment Agency (2020) Europe's Consumption in a Circular Economy: The benefits of longer-lasting electronics. Online via: European Environment Agency (EEA)

47 Merseyside Recycling and Waste Authority (2024) Approved average weights of materials. Online: https://www.merseysidewda.gov.uk/wp-content/uploads/2024/01/Average-weights-of-materials.pdf

48 Merseyside Recycling and Waste Authority (2024) Approved average weights of materials. Online: https://www.merseysidewda.gov.uk/wp-content/uploads/2024/01/Average-weights-of-materials.pdf

49 Merseyside Recycling and Waste Authority (2024) Approved average weights of materials. Online: https://www.merseysidewda.gov.uk/wp-content/uploads/2024/01/Average-weights-of-materials.pdf

50 Assuming an average weight of a vacuum cleaner as 7.5 kg

51 WEEE Forum (2019) Successfully Countering Online Free-riders. Online via: WEEE Forum

52 Environment Agency (2026) Electrical and electronic equipment placed on the UK market. Online via: GOV.UK

53 EEB (2019) Coolproducts Don't Cost the Earth – Full report. Online via: EEB

54 European Environment Agency (2020) Europe's Consumption in a Circular Economy: The benefits of longer-lasting electronics. Online via: European Environment Agency (EEA)

55 Merseyside Recycling and Waste Authority (2024) Approved average weights of materials. Online: https://www.merseysidewda.gov.uk/wp-content/uploads/2024/01/Average-weights-of-materials.pdf

56 Cornelis et al. (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024. Geneva/Bonn.

57 ONS (2025) Households by household size, regions of England and Great Britain constituent countries. Online: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/datasets/householdsbyhouseholdsizeregionsofenglandandgbconstituentcountries

58 Material Focus (2024) UK Electrical Waste: Challenges and opportunities 2023. Online via: Material Focushttps://materialfocus.org.uk/report-and-research/uk-electrical-waste-challenges-opportunities-2023/

59 Groundwork (N.d.) London-based REWORK Launches E-Commerce Shop to Tackle Waste and Promote the Green Economy. Online via: Groundwork

60 The Restart Project (2023) What a waste: our study shows almost half of electricals sent for recycling could be reused. Online via: Restart

61 WRAP (2011) Realising the Reuse Value of Household WEEE: Summary Report Online

62 WRAP (2011) Realising the Reuse Value of Household WEEE: Summary Report Online.

63 Merseyside Recycling and Waste Authority (2024) Approved average weights of materials. Online: https://www.merseysidewda.gov.uk/wp-content/uploads/2024/01/Average-weights-of-materials.pdf

64 Cornelis et al. (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024. Geneva/Bonn.

65 Material Focus (2024) 1,200 battery fires in the waste system reported last year. Online via Material Focus

66 Merseyside Recycling and Waste Authority (2024) Approved average weights of materials. Online: https://www.merseysidewda.gov.uk/wp-content/uploads/2024/01/Average-weights-of-materials.pdf

67 Material Focus (201) Consumer Research: E-waste attitude and behaviours. Online via: Material Focus

68 Material Focus (2022) Business E-waste Challenges and Opportunities – Research report. Online via Material Focus

69 Cornelis et al. (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024. Geneva/Bonn.

70 Environment Agency (2026) Waste electrical and electronic equipment (WEEE): Evidence and national protocols guidance. Online via GOV.UK

71 Environment Agency (2026) Waste electrical and electronic equipment (WEEE): Evidence and national protocols guidance. Online via GOV.UK

72 IEA (2025) Global Critical Minerals Outlook 2025. Online via: IEA

73 UK Government (2025) Vision 2035: Critical Minerals Strategy. Online via: GOV.UK

74 DESNZ (2024) Unlocking Resource Efficiency: Phase 2 Main Report. Online via GOV.UK

75 Environment Agency (2025) Waste electrical and electronic equipment (WEEE): How to be an approved exporter. Online via GOV.UK.

76 Based on the average medium household electricity and gas usage, and DESNZ (2025) Conversion factors 2025. Online via: GOV.UK.

77 Based on the average mileage of a petrol car Department for Transport (2025) Online via: GOV.UK, and DESNZ (2025) Conversion factors 2025. Online via: GOV.UK.

78 Based on the average medium household electricity and gas usage, and DESNZ (2025) Conversion factors 2025. Online via: GOV.UK.

79 WRAP (2011) Realising the Reuse Value of Household WEEE: Summary Report Online.

80 Material Focus (2024) '1,200 battery fires in the waste system reported last year'. Online via Material Focus

81 DESNZ (2024) Unlocking Resource Efficiency: Phase 2 Main Report. Online via GOV.UK

82 WRAP (2011) Realising the Reuse Value of Household WEEE: Summary Report Online.

83 Groundwork (N.d.) London-based REWORK Launches E-Commerce Shop to Tackle Waste and Promote the Green Economy. Online via: Groundwork

84 RREUSE (2025) Targets for reuse & preparing for reuse in the European Union: Research report with policy recommendations. Online via: RREUSE

85 Material Focus (2024) 1,200 battery fires in the waste system reported last year. Online via Material Focus

86 EEB (2019) Coolproducts Don't Cost the Earth – Full report. Online via: EEB

87 European Environment Agency (2020) Europe's Consumption in a Circular Economy: The benefits of longer-lasting electronics. Online via: European Environment Agency (EEA)

88 Based on observed conditions of EEE from WRAP (2011) Realising the Reuse Value of Household WEEE: Summary Report Online.

89 WRAP (2011) Realising the Reuse Value of Household WEEE: Summary Report Online

90 WRAP (2011) Realising the Reuse Value of Household WEEE: Summary Report Online

91 EEB (2019) Coolproducts Don't Cost the Earth – Full report. Online via: EEB

92 DESNZ (2024) Unlocking Resource Efficiency: Phase 2 Electricals Report. Online via GOV.UK

93 WRAP (2011) Realising the Reuse Value of Household WEEE. Online

94 WRAP (2011) Realising the Reuse Value of Household WEEE. Online

95 ReLondon (2026) A Repair Voucher Scheme for London: An overview of different models and their potential impact. London Councils. Online.

96 Circular Regions (N.d.) Reparaturbon. Online via: Circular Regions

97 WRAP (2024) Divergencies between the UK WEEE & EU WEEE Extended Producer Responsibility (EPR) systems. Online via: WRAP.

98 Globally, two collection targets are commonly used, the first of which is based on an average share of EEE placed on the market in the preceding three years. The second type of collection target is based on a share of WEEE generated in the same year. In the UK, the tonnage target for WEEE collection is based on 65% of the average EEE placed on market over the preceding three years, which is similar to the collection target outlined the EU in the WEEE Directive.

99 Excluding Poland which reported over 100%. European Environment Agency (2025) Waste electrical and electronic equipment (WEEE) collection rate (Indicator). Online via European Environment Agency (EEA)

100 European Environment Agency (2025) Waste electrical and electronic equipment (WEEE) collection rate (Indicator). Online via European Environment Agency (EEA)

101 Messmann et al. (2019) Potentials of preparation for reuse: A case study at collection points in the German state of Bavaria. Journal of cleaner production 211.

102 Material Focus (N.d.) Veolia Southwark. Online via: Material Focus

103 Ecosweee (2023) Best Practice Collection Initiatives Booklet. Online via: ECOSWEEE

104 Based on the average medium household electricity and gas usage, and DESNZ (2025) Conversion factors 2025. Online via: GOV.UK.

105 Forti V., Baldé C.P., Kuehr R. (2018). E-waste Statistics: Guidelines on Classifications, Reporting and Indicators, second edition. United Nations University, ViE – SCYCLE, Bonn, Germany.

ReLondon

Sustainable Workspaces,
5th floor,
County Hall,
Belvedere Road,
London SE1 7PB

/company/relondonuk/

relondon.gov.uk