Evidence Submission

Environmental Audit Committee inquiry on electronic waste and the circular economy: follow-up

8th April 2024

About us

With more than 50,000 members in over 100 countries and a knowledge business that spans the globe, the Royal Society of Chemistry is the UK's professional body for chemical scientists, supporting and representing our members in large multinational companies and small and medium enterprises, universities, schools, government and regulatory agencies. We also draw on chemistry using professionals' expertise to provide advice to Government to help it achieve its ambitions, whether regulating chemicals appropriately and responsibly[1], identifying priorities, opportunities and challenges in the chemical sciences[2], or supporting the development of a UK circular economy[3].

The Royal Society of Chemistry would be happy to discuss any of the issues raised in this submission in more detail, please contact policy@rsc.org

Summary

Unsustainable resource use is driving the triple planetary crisis of climate change, biodiversity loss and waste and pollution[4]. Currently, we have a largely linear economy where resources are extracted with significant environmental and health impacts [4] used in products and services, before being thrown away as waste. To use resources more sustainably, we need to move to a circular economy model. This is where resource efficiency is maximised, materials are kept circulating at as high a value as possible and waste and pollution are minimised. Currently, some estimates suggest that the UK's material flows are only 7.5% circular[5]. A circular economy will also help to address some of the supply of security concerns facing many of the materials (e.g. lithium, indium and rare earth elements) that are essential not only in the technologies that will help the UK transition to net zero, but also in a range of other sectors including security, healthcare and electronics.

The Royal Society of Chemistry welcomes the renewed focus that this special inquiry brings on addressing the complex challenge of waste electrical and electronic equipment (WEEE), an issue we have long been highlighting through our *Precious Elements* campaign[6]. While the recent WEEE consultations outlined several proposals that we welcomed the intention behind, there remains a lack of clear overarching strategy that will enable a circular economy of materials in the UK. Our response highlights some of the reasons why material recovery from WEEE remains challenging.

Our asks in brief

We stress the importance and urgent need for a coherent suite of policy interventions by UK government in this space which includes:

1. Investment in recycling and repair infrastructure for WEEE,
2. Improvement in data collection including the mapping and tracking of critical mineral and other material streams within WEEE.
3. Incentivising resource-efficient design and production alongside assessments of criticality and substitutability of materials.
4. Investment and support for further research and innovation in recycling methods.

Implementing a circular economy for electronic goods

How can secondary markets for electrical goods be improved? What incentives are required to implement these markets?

Understanding the industrial need domestically for critical minerals and other materials recovered from WEEE and how this may change over time (e.g. due to growth in renewables) will be important when considering the domestic versus export market. At present, there are some examples of materials recovered from WEEE being used as secondary raw material, e.g. by the Royal Mint. However, increasing the usage of secondary raw materials so this is done at scale will likely require incentivisation or regulation by Government. Alongside this, facilitating cross-sector collaboration to enable the circularity of materials, components and products at industry level will be important in helping to close loops and establishing the usage of secondary raw materials.

Why does recovering materials from electronic waste pose a significant challenge? How has this changed since 2020?

Recovering materials from electronic waste poses a significant challenge for several interlinked reasons including:

(i) Collection, infrastructure, and the role of consumers

For the recovery of materials from WEEE to be successful and economically viable, WEEE must enter the formal recycling system reliably and at sufficient scale. In addition, in a circular economy, repair, re-use, and re-manufacturing are also vital alongside recycling to ensure that material flows are slowed, and consumption and waste are minimised. Consequently, consumers play a pivotal role because they determine what happens to EEE when it is no longer being used and the path (repair, reuse, recycling, storage, landfill) that an item takes next. A barrier to the collection of WEEE for consumers is the convenience of recycling options. In a survey conducted by the Royal Society of Chemistry and 3Gem, just over half of respondents said they worry about the environmental effect of the unused devices they have at home, but either do not know what to do with them or are unconvinced the current processes available in their local area deal with e-waste effectively[7]. While improving the convenience of collections is likely to be important in increasing recycling and re-use rates, addressing other barriers to re-use and recycling such as data security concerns and knowledge and awareness of recycling options as part of a suite of measures is likely to be important. In the survey conducted by the Royal Society of Chemistry and IPSOS Mori[8], concerns about security and that data could be stolen were identified by respondents as reasons for not recycling old or unused devices by 28% and 24% of respondents respectively.

(ii) Data, targets, and material tracking

To support recovery and re-use of materials and components, understanding the scale of the 'urban mine' is important. There appear to be a number of data gaps in the current WEEE system which all contribute to making this challenging. Accurate assessments of WEEE flows are lacking, particularly around what happens to WEEE that is not recorded as being collected and recycled according to the mass-based targets. As the previous inquiry concluded, the extent to which the UK's collection targets are being met is unclear. The recently published 2024 Global E-waste Monitor indicates that there appears to have been a drop in the amount of WEEE collected and recycled from 2019 to 2022[9], although data from Defra shows that the WEEE collection targets were met in the UK for 2023. The UK remains the second biggest contributor of WEEE per capita globally, and there has been a growth in WEEE generation from an average of 23.9kg per capita in 2019 to 24.5kg per capita in 2022[9].

Mass-based targets as in the current system do not give an indication of, e.g., critical mineral flows, or any kind of environmental weighting to the type and composition of WEEE. In the reformed WEEE system, data need to be collected at sufficient granularity not only to be able to map and track critical mineral and other material flows which will support recovery and re-use of specific materials, but also to have an accurate understanding of the scale of WEEE that is available for mining now, and in the future. A mass-based metric also does not take into account the complexity of recycling an item. For example, washing machines have a high mass while tablets are much lower mass but due to their construction are more challenging to recycle.

Another issue with the current method of producing targets based on EEE generation, is that product lifetimes may differ, and in addition storage and hoarding behaviour of small WEEE (sWEEE) is also common. In a nationally representative survey carried out in 2019 by the Royal Society of Chemistry and IPSOS Mori, 51% of UK households had at least one unused electronic device [8]. Not only are many households storing items, but these can also be stored for a number of years. For example, in the RSC survey the average age of the oldest unused laptop was 9 years, and that of a smartphone 7 years [8]. This storage behaviour means there is potentially a long disconnect between EEE being placed on the market, and the disposal and collection of it, which may make accurate forecasting problematic. The storage of many small items of EEE at the end of their use phase acts as a barrier to circularity on material, product and component level. If items are stored for many years, the likelihood that the product will have reached obsolescence, e.g. because of hardware or software incompatibility, will increase, therefore rendering the product useless.

When it comes to re-use and recovery of materials and components, the items need to be entering in quantities that are economically viable to disassemble them, although if and when supply chains of critical minerals are disrupted the economics of this is likely to change over time. In addition, future improvements, e.g. the increased use of robotic disassembly methods, may help to mitigate some of these economic viability considerations. If items have been stored for long periods, it means that it is more likely that they will not be entering into the waste system in these kinds of quantities. While the materials that an obsolete piece of WEEE contains will likely still have the same value as those recovered from non-obsolete WEEE, there is a decreasing chance that components can be recovered and re-used in a new product. Ultimately, it seems likely that the longer an item is stored for before entering the circular economy, the more likely it is that it will not be following as tight a loop and therefore its potential value will not have been optimised.

Collecting additional data and evidence, including around (i) actual product lifespans, (ii) storage behaviour by consumers (iii) amount of WEEE entering other waste streams and landfill and (iv) amount of WEEE sent for re-use, may help to improve overall understanding of WEEE flows in the UK. Any new targets or performance measures will need to be carefully implemented to ensure they are collecting useful, measurable data, as well as ensuring that there is transparency about whether targets are being met or not.

(iii) Recycling techniques

The widespread shredding and incineration of WEEE means that potentially large quantities of critical minerals and other materials are currently either being lost from the system, or their potential value decreased. This may need to be specifically addressed either by targets or via other measures that mandate recovery at a specific value level. Investment will be needed in recycling infrastructure if a growing range of materials are to be recovered. The use of different technologies that are better able to separate out individual materials will be needed. For example, pyrometallurgical processes have a high energy demand and high greenhouse gas emissions. Alternative processes such as hydrometallurgy or bio-based recovery may be better at separating and recovering materials; however, these need to be scaled up and the uptake of new technologies by the sector can be slow. Some of this may be down to the regulatory and economic environment within the waste sector, and therefore would need to be addressed to support implementation of new technologies. Assessment of the relative environmental impacts of recycling technologies is important to ensure assumptions are not made about which processes are 'greenest'. There will always be trade-offs between the different processes, but a better understanding of these would help support decision making. Assessments should be done at both research and industrial scale. One of the challenges at the research phase of doing lifecycle analysis is access to data that are needed to perform analysis. These data are often classed as commercially sensitive or may be expensive to access. Mechanisms to facilitate access to sensitive data for life cycle analysis, or for reasons that have been outlined previously in this response, would help to support necessary research in these areas. Full lifecycle assessment from 'cradle to cradle' is also important. Any recycling process will have an energy expenditure whether it is in the solvents used in hydrometallurgy or a smelter in pyrometallurgy. However, this should be weighed against the energy and environmental impacts of primary extraction and processing to avoid 'burden shifting' around the system. These kinds of assessments are often lacking at present. Further work should be done to assess and quantify the environmental impacts (positive and/or negative) of a move to a circular economy.

Some types of WEEE are projected to grow substantially, for example consumer electronics [9] and solar PV[10]. This means that the UK needs to have built the capacity and infrastructure to cope with increased amount of WEEE associated with these products or will risk the continued loss of critical and valuable materials if these are exported for processing.

(iv) Product design

Products need to be designed in ways that meet eco-design principles – design for disassembly for both repair and end-of-life recovery is important. For example, better product design can help address the complexity of materials which are being used in a product as this can pose a problem for recycling. The UK Right to Repair Law signals a welcome intention to increase repair rates; however, it is limited in scope at present. EU legislation such as the Eco-design Directive and Right to Repair legislation may be useful models for developing this kind of legislation further. In addition, some coherence with EU and other legislation is likely to be helpful for producers. One of the principles of a circular economy is to keep materials circulating at their 'highest value' for as long as possible, and within the tightest loops of the circular economy. Therefore, a balance may need to be struck between durability, repairability, re-manufacturability, and recyclability of products. Facilitating discussions of this nature may be valuable for the various actors in the EEE value chain.

(v) *Hazardous materials*

Within the UK, items that do not get collected in the WEEE stream will be contaminating other waste streams or entering landfill. Both are potentially challenging for the safe management of the hazardous materials that it contains. For example, municipal waste incineration is often not hot enough to fully combust PFAS (per-and polyfluoroalkyl substances). If WEEE contaminates normal municipal waste streams, it is likely that PFAS will not be fully mineralised and could seep into waterways which can lead to a range of issues.

Incentivising the move away from hazardous chemicals towards greener alternatives, e.g. via the proposed eco-modulation criteria set out in the consultation, could be useful if done in an appropriate way. Banning chemicals on a named basis may not be the most effective way of doing this as it may encourage the use of chemicals with similar compositions and similar impacts being used as replacements. In addition, this does not address existing legacy contamination, such as polychlorinated biphenyls (PCBs). Reviewing product standards may also be important as some chemicals or materials may be being used by default (e.g. flame retardants) when they are not strictly necessary for the product in question. Better product labelling of what is contained within an item, including where the hazardous materials are located, would probably be beneficial to treatment facilities. While incineration is important to treat hazardous substances, it means that important and valuable materials are lost as has been outlined in section iii. In addition, incineration has a high energy demand and significant greenhouse gas emissions. Therefore, the treatment of hazardous chemicals needs to be balanced with material recovery and other environmental impacts. This may require additional processing steps so that materials can be recovered, and hazardous chemicals treated appropriately.

PFAS are prolific chemicals in WEEE and should be managed appropriately if they are not already. To support this, ensuring the many hundreds of sources of PFAS are reported and captured in a national inventory is vital. Companies need to know what PFAS they are using, even if the chemical comes from further up in their supply chain, e.g. in equipment or ingredients that are used in their process. Our work on PFAS[11] highlights some of the issues that can occur if these 'forever chemicals' end up in the water supply.

The UK's electronic waste sector

What action can the UK Government take to prevent to the illegal export of e-waste to the developing world?
The previous inquiry concluded that the UK is illegally exporting WEEE to the developing world. The improper disposal or processing of WEEE has both environmental and human health impacts due to the hazardous chemicals that WEEE contains. WEEE that is shipped abroad may not be subjected to the same treatment standards as in the UK, risking these environment and health impacts being displaced to other countries. Therefore, action to prevent the illegal export of WEEE is vital. Re-use of EEE is important in a circular economy. Whether something is re-usable may differ depending on country context, and items that are no longer classed as re-usable in the UK may potentially be appropriate for re-use elsewhere. However, precautions should be taken to ensure that items shipped abroad that are designated as 'usable EEE' (UEEE) are in fact usable and are not being shipped in this manner to avoid restrictions on the illegal shipping of WEEE. Some of the academic literature suggests that ambiguity in the wording of the Basel Convention may be one of the reasons for the illegality of exports. Reforms to the WEEE system may therefore be an opportune moment to tighten any ambiguity on what counts as UEEE vs WEEE from the UK perspective.

Has the UK Government considered all essential aspects of tackling WEEE in its consultation?
The Royal Society of Chemistry welcomed the intention behind many of the proposals that were set out in the WEEE consultations. However, there is a clear need for a coherent suite of interventions that address the complex challenges presented by WEEE if we are to enable a circular economy of the materials it contains. Currently, there is no clear overarching strategy that sets out how the UK will transition to a circular economy. This raises the risk that important actions could fall in the gaps between policies and strategies, or progress of transition will be slowed or stalled. Driving the transition to a circular economy will require long-term, coherent policies and co-ordination and alliances with global partners for several reasons:

i) Ensuring co-ordination between different parts of the value chain for materials, for example between product design and waste management, will help to minimise the risk of 'burden shifting' of environmental impacts from one part of the value chain to another.
ii) The UK has a limited capacity to source the materials needed in the net zero transition from within the country particularly as circularity is not yet established, hence collaboration and co-ordination with global partners is needed to ensure material demands can be met. Global collaboration and coordination would also be needed for access to resources to be fairly and equitably distributed among countries.
iii) A combination of incentives, product regulation, materials inventories, and infrastructure investment is required to enable a circular economy. Therefore, we need strategic oversight from government to ensure that these approaches are synergistic.

We also welcomed the proposals to introduce measures to increase re-use of EEE since in a circular economy, repair, re-use, and re-manufacturing are vital. By implementing waste hierarchy principles[12], material flows can be slowed, and consumption and waste minimised. However, lack of repair infrastructure may continue to act as a barrier to re-use and repair unless this is developed alongside recycling infrastructure.

In addition, there is potentially a skills need or gap and work should be done to ascertain the magnitude of this. The chemical sciences are integral across the WEEE value chain. Recent analysis carried out by the Royal Society of Chemistry suggests that chemistry jobs are projected to grow in the waste collection, treatment and supply/disposal sector[13]. Many of the challenges and barriers that need to be overcome in enabling a circular economy are trans-discipline and trans-sector. Facilitating relationships and synergies between different sectors and parts of the value chain will be essential.

Is UK public awareness of e-waste recycling satisfactory? If not, how can it be improved?
Public awareness of WEEE recycling is unlikely to be satisfactory. For example, in a survey conducted by the Royal Society of Chemistry and IPSOS Mori, 21% of respondents said they did not know where they would take items for recycling, and 18% said they would not know how to arrange to have WEEE recycled [8].

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[5] The Circularity Gap Report: the United Kingdom. Circle Economy and Deloitte, 2023.
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