Written evidence submitted by Royal Society of Chemistry

Critical raw materials in waste electrical and electronic equipment

Critical raw materials (CRMs) are materials that are important to a nation, region or sector's economy and that are, or could become difficult to get hold of. Examples of CRMs, as identified for the European economy[1], include indium, which is used in touchscreens and solar panels, and tantalum, which is used in microcapacitors for a range of applications from mobile phones to wind turbines.

2019 is the International Year of the Periodic Table, and this has made us, at the Royal Society of Chemistry, think about the amazing applications, but also the supply risks of some of the elements. Several elements that are important in electrical and electronic equipment (EEE) such as mobile phones, tablets and smart TVs, have associated supply risks. At the same time, waste EEE (WEEE) is the fastest growing waste stream on the planet. Risks could be mitigated by reducing the use of CRMs, increasing the re-use of products or components that contain CRMs and increasing CRM recycling rates. Chemical scientists have a key role to play in this, by developing alternative materials, informing designers on the lifecycle and degradation profile of alternatives, and finding effective ways to extract elements from used devices. However, they cannot face this challenge alone and concerted action is needed from government, manufacturers, retailers and consumers to reduce, re-use and recycle CRMs in (W)EEE.

To decrease supply risks and enable the continued use of CRMs in EEE as well as in medical applications and sustainable energy solutions, the RSC recommends that more ambitious measures to improve the resource efficiency of CRMs should be set out in the implementation plans of Resources & Waste Strategies across the UK, based on the following four principles:

1. **Reduce and re-use**: Measures should focus on reducing the amount of CRMs being used and re-using devices containing them, following the principles of the 'waste hierarchy', rather than primarily focusing on increasing recycling rates.
2. **Working together**: Government, academia, industry and society must work together in a 'Quadruple Helix' collaboration towards common sustainability goals for CRMs, and begin by enabling tracking CRMs in product supply chains by covering CRM streams in the National Materials Datahub[2].
3. **Invest in R&I**: Funding budgets for research into development of CRM substitute materials, collaborative work with designers, and scale-up and commercialisation of recovery processes must be matched with the expected demand of CRMs required to achieve the government's strategic innovation ambitions.
4. **Product requirements**: UK product requirements should include lifecycle impact reporting to assess environmental impact, eco-design to ensure that products can be cost-effectively upgraded, repaired, remanufactured and disassembled, and product labelling to inform and empower consumers. Implementation plans in the UK must include maximum efforts for global harmonisation.

Critical raw materials

Critical raw materials (CRMs) are materials that are important to an economy and that are, or could become difficult to get hold of in the future. The list of CRMs that is most relevant to the UK currently is the 2017 list of the European Commission[1], which contains 27 materials that are 'critical' due to their high economic importance combined with high supply risk for the European economy. CRM lists also can be determined at national (a list covering the UK currently does not exist), regional and sectoral level. Such lists are more specific and hence more relevant to the region or sector, provided that they are updated regularly.

Demand for CRMs is expected to increase as these materials are required in equipment needed for the use of AI[*], machine learning and innovative care technologies, that are being produced and used in increasing amounts. CRMs such as indium and tantalum are currently irreplaceable in solar panels, wind turbines, electric vehicles and technologies to enable the fourth industrial revolution. Notably, the production of low-carbon technologies to mitigate climate change and curb global emissions is expected to increase the demand for certain raw materials by a factor of 20 by 2030.[3]

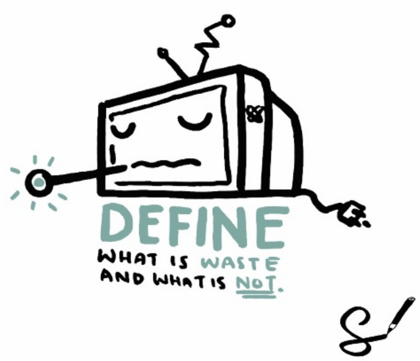
Waste electrical and electronic equipment

The category of Household WEEE that contains most CRMs is Small WEEE. Small WEEE includes: small household appliances; IT & Telecoms equipment; consumer equipment; lighting equipment; electrical & electronic tools; toys, leisure & sports devices; medical devices; and monitoring & control instruments.[4]

A nationally-representative survey[5] by the RSC revealed a concerning trend in consumer habits regarding their household electronics. Currently, 82% of UK households with unused devices, including mobile phones, computers, smart TVs, MP3 players and e-readers, have no plans to recycle these. Moreover, this problem is set to grow, as the survey showed that young people own increasing amounts of gadgets and tech devices. A range of factors prevent people from recycling their devices, including keeping them as spares, risks around data security, and a lack of knowing where to take them. Notably, respondents indicated that they would be more likely to recycle devices when aware of the scarcity of some elements that they contain.Therefore, increasing awareness, for example through campaigns like '…' launched by TechUK, is a necessary first step.

1. Reduce and re-use: following the waste hierarchy[6]

If we all started recycling our devices today, the current infrastructure to collect and recycle WEEE would prove far from sufficient to process the input. Our community is therefore concerned about the focus on recycling in England's Resources and Waste Strategy[7] rather than the waste hierarchy principles in their totality. Mechanically destroying devices and chemically recycling materials must not be the first priority. Decreasing the use of CRMs, as well as increasing re-use and repair of products they are used in, are just as important if not more so.



Much more attention should be given to reduction of CRM use, and re-use of products that contain CRMs, for example by incentivising CRM substitution where possible (reduce) and offering convenient product take-back schemes that guarantee secure data wiping and look at re-use first (re-use).

2. Working together: enabling a circular CRM economy through 'Quadruple Helix' collaboration

Efficient recovery of CRMs from devices at present faces considerable barriers. Major national, EU-level and global challenges that still need to be overcome include;

- a lack of regular **assessment of critical materials for specific regions and sectors in the UK**;

[*] AI technology is expected to increase demand but can also be part of the solution; the Critical Elements and Materials (CrEAM) Network is exploring the use of AI for robotic disassembly of EEE.

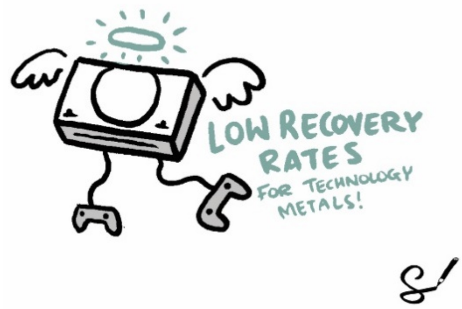
- a lack of **awareness in society** around CRM supply risks;
- a lack of adopted **design principles for circularity** that will enable cost-effective upgrade, repair, remanufacturing and disassembly for recycling of product components and products;
- a lack of **economic models and digital data solutions** that connect collection facilities with re-use/recycling infrastructure and the producers that could use secondary components or materials;
- a lack of the **ability to identify where the CRMs are present in components and products** and the need for globally harmonised reporting and labelling methods to facilitate this;
- a lack of critical **infrastructure** to make chemical/mechanical recycling and CRM extraction economically viable;
- a lack of commercially available **technological solutions at scale** for materials separation from complex product component matrices.

The nature and breadth of these challenges require a concerted 'Quadruple Helix' approach, where government, academia, industry and society work together towards common sustainability goals.
One of these key challenges, the lack of data solutions to track CRMs and bring the supply chain together, should begin to be addressed by covering CRM streams in the National Materials Datahub.

3. Invest in R&I: ensuring that future CRM demand is met

The UK Government has in its Industrial Strategy set out four Grand Challenges to put the UK at the forefront of the industries of the future, and is developing ambitious missions to tackle these.[8] It is worth noting that tackling each of these challenges – AI & data, ageing society, clean growth and the future of mobility – will rely on technological developments that are all expected to heavily rely on CRMs.

To ensure that the UK is in a position to deliver its strategic innovation ambitions, funding budgets for research (and training of researchers) towards the substitution of CRMs and the separation of materials at scale should be set to match the projected demand of CRMs. This will require development of new materials to substitute CRMs, collaborative work with designers to enable design for circularity including resuse and recovery of product components and recycling of CRMs, and scale-up of recovery processes. CRMs are lost as waste products from currently-used recovery processes that focus on recovery of metals such as gold, platinum and copper. Extraction processes that would enable a much broader range of materials, including CRMs, to be recovered have been developed at laboratory scale, but investment is needed for these to be commercialised.



4. Product requirements: requiring lifecycle impact reporting, eco-design and product labelling

Product requirements that must be implemented to achieve a circular economy include;
- a product's lifecycle impact should be reported and products should have a maximum permissible impact on the environment throughout their lifecycle;
- material choice and substitution decisions based on assessment of criticality in terms of resource availability, lifecycle and social impact (versus product performance) should be incentivised;
- design requirements should ensure that products can be cost-effectively upgraded, repaired, remanufactured and disassembled[9], and should be relevant in the context of available repair and recovery infrastructure;
- products should have labels setting out how easy it is to repair and disassemble them, to inform consumers and empower them through their product choices.

Many of these requirements will be implemented in the UK when transposing agreed standards, including as part of the 'Circular economy action plan'[10] and new WEEE regulations[11] developed under the 'Eco-design directive for energy-related products'[12]. For these standards to enable a global circular economy, implementation plans in the UK must include maximum efforts to harmonise regulations globally.

Contact

The Royal Society of Chemistry would be happy to discuss any of the issues raised in our statement in more detail.

About us

With about 50,000 members in 120 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 and bringing together chemical scientists from all over the world. Our members include those working in large multinational companies and small to medium enterprises, researchers and students in universities, teachers and regulators.

The Royal Society of Chemistry developed this position drawing on evidence from chemical scientists working on these issues. The chemical sciences play an important role in understanding the environment around us, including preventing and remediating the adverse impacts of waste from human activity. There are numerous ways in which chemical scientists are working towards a sustainable, clean and healthy planet, and this statement is part of our contribution to do so.

August 2019

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[1] Third list of critical raw materials for the EU of 2017, European Commission, September 2017
[2] DSC-69 National Materials Datahub, Data Science Campus, April 2019
[3] Scoreboard depicts the state of play of raw materials in the EU, EU Science Hub, July 2016
[4] WEEE Material Flows Model and Report, WRAP UK, February 2016
[5] Elements in Danger Survey, The Royal Society of Chemistry, August 2019
[6] Guidance on applying the Waste Hierarchy, Defra, June 2011
[7] Our waste, our strategy: a strategy for England, HM Government, December 2018
[8] Industrial Strategy: the Grand Challenges, Department for Business, Energy & Industrial Strategy, November 2017
[9] Better products by design, Green Alliance, October 2016
[10] Closing the loop - An EU action plan for the Circular Economy, European Commission, December 2015
[11] General method to declare the use of critical raw materials in energy-related products, CENELEC, March 2019
[12] DIRECTIVE 2009/125/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a framework for the setting of ecodesign requirements for energy-related products, European Commission, October 2009