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Research Brief

Material footprints of ICT and Entertainment & Media

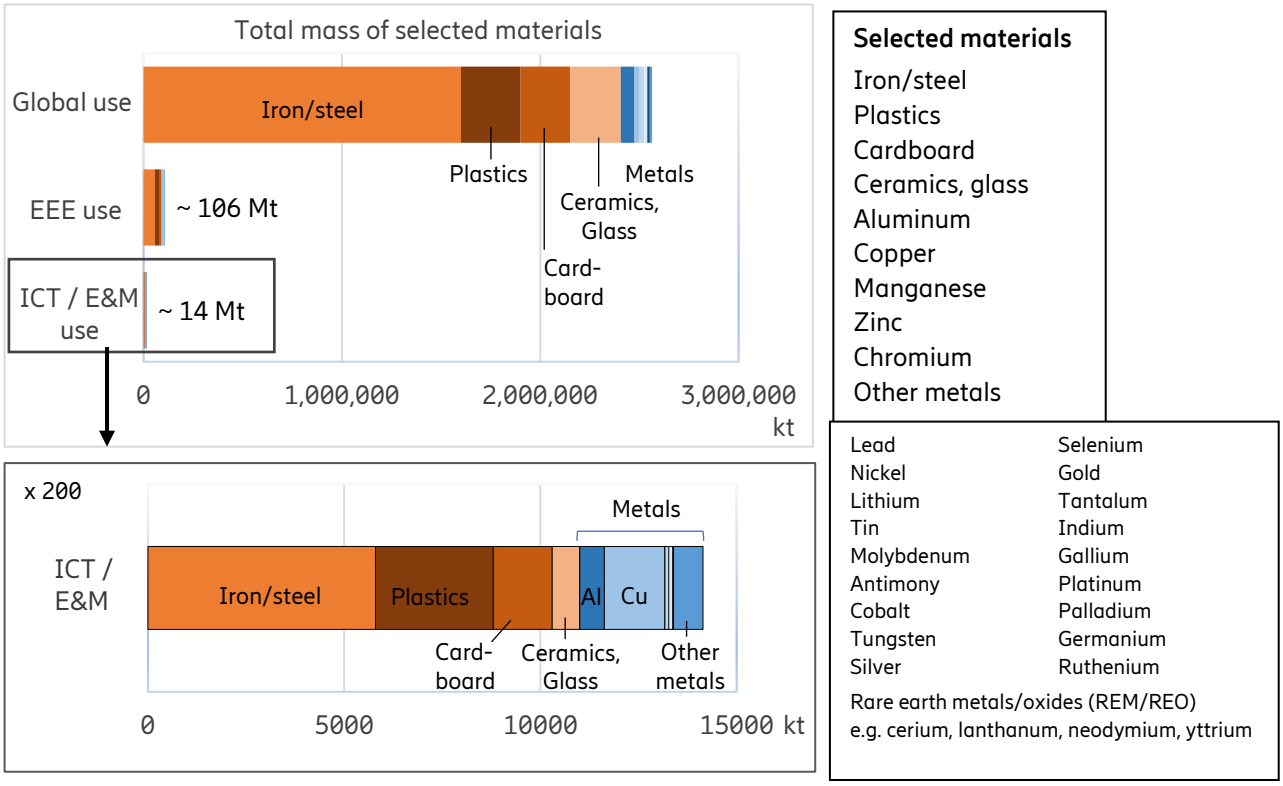
The Information and Communication Technologies (ICT) and the closely related Entertainment & Media (E&M) sectors make use of the earth's resources in their products. The main materials used within ICT and E&M products were estimated to be about 0.5% of the total weight of the global annual usage of these materials, while the sectors are main the users of some materials with over 80% share. Also, toxicity, resource depletion and carbon emissions associated with the use of materials need understanding. The material carbon emissions and toxicity footprints were found to be somewhat higher than the weight shares imply, while resource depletion is significantly higher. All of these would reduce with increased recycling rates.

ICT small share of total use of materials

The long-term supply of materials needs to be secured by carefully monitoring the use of materials. All materials of relevance for the Information and Communication (ICT) and Entertainment and Media (E&M) sectors were included in the study.

Material footprints are closely related to the concept of circular economy. Estimations on recycling greatly influence the results except for the footprint looking at the material's total mass (measured in kilogram or metric ton). For the selected materials the so-called total mass material footprint – hence the total mass of materials used for one year – corresponded to 14 million tonnes. This was about 0.5% of the global use of these materials.

Electrical and electronic equipment (EEE) in general used about 4% of the same materials. For some rare metals the share is significantly higher though. For instance, ICT and E&M usage represent over 80% of the overall usage of indium, gallium and germanium looking at mass.

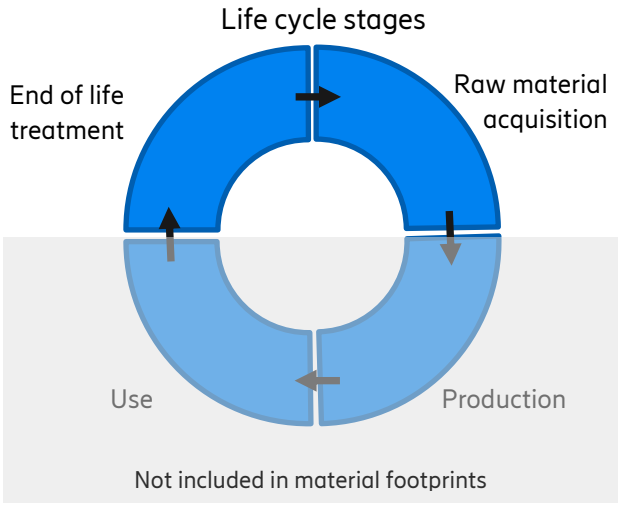


Material carbon footprint about 0.9%

The greenhouse gas (GHG) emissions related to the overall global use of materials have grown in the latest decade. This is mainly due to the increased production of steel and cement. The so-called material carbon footprint is the GHG emissions related to raw material acquisition.

The material carbon footprint was estimated to be about 0.9% of the carbon footprint for the selected materials using a world average recycling scenario for the ICT and E&M sectors. That corresponds to about 0.1% of the overall global carbon footprint, including land use.

Depending on the assumed recycling rate, the estimated material carbon footprint varies between 0.6% and 1.3% of the footprint of the selected materials. The lower value corresponds to a recycling rate of ninety percent while the higher value corresponds to no recycling at all.



Naming of footprints

Materials mass footprint (metric tonnes)	Materials carbon footprint (GHG, CO_2-eq)
Materials toxicity footprint (human & eco-system)	Materials resource depletion (footprint)

Copper has the main impact in material toxicity

Material toxicity footprint looks at the exposure of toxic substances to eco-systems and humans from raw material acquisitions and the end-of-life treatment life cycle stages for equipment produced in one year. For ICT and E&M, the total material toxicity footprint was estimated to be about 3% of the impact related to the global use of the selected materials, including cement production which is included in this footprint for input data reasons.

Copper followed by gold were the key contributors to the human and ecosystem toxicity potentials. Other materials of special interest were zinc, lead and silver. Due to inherited methodological reasons, uncertainties are very high for toxicity potentials, but the results indicate that ICT and E&M sectors play a larger role in terms of toxicity footprint than expected from only considering their mass.

If full recycling could be obtained the toxicity potentials could become nearly zero, but without any recycling the potentials could become nearly twice as high as estimated here.

The use of resources

Resource depletion is when resources are being consumed faster than they can recover. Some raw material resources, including certain metals, have become scarcer over the years. The material resource depletion footprint relates to the scarceness of the used raw materials.

Different methods exist to estimate resource depletion and the uncertainty is high. Every material has a corresponding value for what experts refer to as its global abiotic depletion potential – a relative value which shows how serious the depletion of one particular natural resource is compared to that of another. To estimate material resource footprint, this value is multiplied by the weight share for each of the selected materials.

ICT and E&M's share of resource depletion was estimated to be 13% applying the most commonly adopted methodology and without considering any recycling. Another impact assessment method gave a material resource footprint result of 48% without any recycling.

Including the current average recycling figures lowered the estimated depletion to 7%. Recycling is key to minimize resource depletion in general. Resource depletion would approach 0% if all materials could be recycled properly.

For material resource depletion related to ICT and E&M, the key metals are gold and copper and the other metals mentioned in relation to toxicity, but also antimony, indium and geranium.

Increased recycling needed

Estimation of global material footprints for an entire industry sector includes different kinds of uncertainties, from parameter to model and scenario uncertainties. In these estimations the production yields have not been considered and might add another 10% to the derived footprints.

To decrease the impact from materials, it is important to increase reuse and sharing to prolong the lifetime of the products made from the materials. However, the most important measure is to recycle metals, especially rare ones like gold and copper. In a circular economy the recycling rates need to approach 100% to conserve materials for use by future generations.

Reference to full paper:
Malmodin J., Bergmark P., Matinfar S. (2018). A high-level estimate of the material footprints of the ICT and E&M sector, ICT for Sustainability 2018. EPiC Series in Computing. Vol. 52, 2018, pp 168-186.