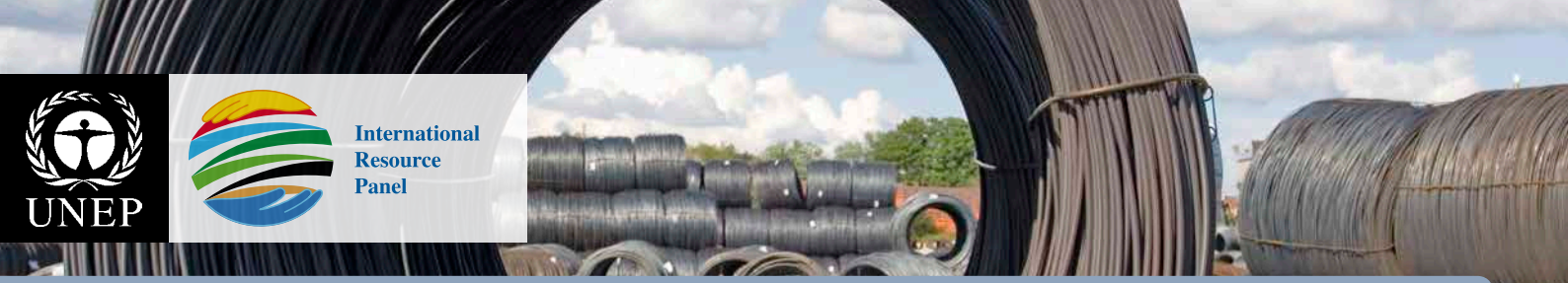

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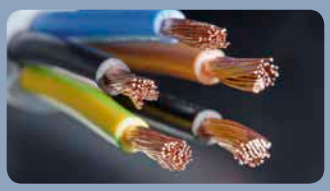


Assessing Global Metal Flows –

ENVIRONMENTAL RISKS AND CHALLENGES OF ANTHROPOGENIC METALS FLOWS AND CYCLES

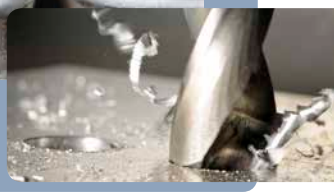
The unique properties of metals make them essential for many applications and future global demand is predicted to increase. Given this relevance the report of UNEP's International Resource Panel on "Environmental Risks and Challenges of Anthropogenic Metals Flows and Cycles" focuses on the environmental impacts related to metals and means of reducing these impacts. It confirms that anthropogenic metal cycles can have orders of magnitude larger than natural metal cycles. Emissions to the environment, however, are roughly of the same order of magnitude as natural emissions. Nevertheless, the global primary production of metals shows a large share of the world's energy use and causes severe local environmental impacts.

Anthropogenic metal cycles

Since the mobilization of metals is greatly increased by mining, metal cycles show a large anthropogenic contribution. The anthropogenic metal flows and corresponding potential emissions depend strongly on the demand situation for each specific metal: In the case of declining demand (e. g. cadmium or mercury) emissions from old stocks dominate; in the case of growing demand emissions related to primary production (mining, refining) and use prevail. Interestingly, the anthropogenic metal emissions to the environment are increasingly dominated by non-metal sources (e. g. fossil fuels, phosphate fertilizers) reflecting the increasing global use of fossil energy carriers and the growth of intensive agriculture. While it has been impossible to differentiate between anthropogenic and natural contributions to environmental metal concentrations on a continental scale, increased concentrations due to anthropogenic point source emissions have been evident at a local scale.

Metals production and energy use

The global metals sector shows a tremendous impact on the world's energy use, as primary metals production is responsible for 7–8 % of the total global energy use. The specific energy requirement varies significantly from 20 MJ (steel) to 200,000 MJ (platinum) per kg of metal produced. Nevertheless, due to their large production volumes, steel, aluminium and base metals account for the largest share in absolute terms. Despite significant potentials for increasing energy efficiency in the primary metals sector using currently available technology, declining ore grades for some metals (e. g. gold, copper, nickel) could increase even further the energy demand for primary production. Secondary production of metals requires significantly less energy per kg metal produced as fewer steps are involved and in most cases the initial concentration of the desired metal is considerably higher in scrap than in natural ores. Therefore recycling must form a very important part of a sustainable metals management.



Environmental impacts of metals

Impacts on the environment occur along the whole life cycle of metals and affect air, water, land, and biodiversity. Primary metals production causes severe local impacts through mining, beneficiation and refining. A wider implementation of Best Available Technologies (BAT) and stricter control are needed here. At the End-of-Life recycling helps reduce the footprint of primary production but also has impacts of its own and landfill is linked to potential contamination of soil and water. Thus, waste prevention, recycling and the use of BAT for final disposal should be supported.

Life cycle assessment of metals

When discussing mitigation options for the environmental impacts of anthropogenic metal flows, a life cycle perspective is obligatory for informed decision-making in order to avoid the shifting of burdens from one stage in the life cycle to another: Here, life cycle assessment (LCA) proves to be a key tool. While it has shown that metals often contribute significantly to life cycle emissions due to high energy intensity in production, it reveals that the use of certain metals can also reduce life cycle emissions (e.g. electric vehicles, light weight alloys). Comparative LCA are also needed to detect the real effects of longevity, material efficiency, and substitution.

Outlook

A continued global rise in metals demand is currently predicted for the decades ahead due to urbanization and the build-up of infrastructure in developing countries and the adoption of new technologies in the energy system as well as in industry and consumer products. This potentially increases the environmental impacts related to the primary production of metals. In order to reduce local risks and impacts as well as energy demand advanced mining concepts and the use of BAT should be fostered through multilateral agreements. Improved End-of-Life recycling rates provide secondary metals for the market and thus generally mitigate the environmental impacts of overall metals production. However, they can only have a significant share in supply when global demand levels off. This may happen in the more distant future. In the decades ahead, primary production will still make up the major part of supply. Therefore a "greener" global primary metal sector remains a "must". For metals which are no longer used by society an environmentally sound "final sink" is needed. Moreover, metal emissions from non-metal sources should be addressed. In this respect, a shift to renewable energies and an extensive agriculture will form major contributions to sustainable metals management.

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http://www.unep.org/resourcepanel

UNEP's International Resource Panel was established in 2007 to provide independent, coherent and authoritative scientific assessment on the sustainable use of natural resources and the environmental impacts of resource use over the full life cycle. By providing up-to-date information and the best science available, the Resource Panel contributes to a better understanding of how to decouple human development and economic growth from environmental degradation.

The Global Metal Flows Working Group aims at contributing to the promotion of reuse and recycling of metals and the establishment of an international sound material-cycle society by providing scientific and authoritative assessment studies on the global flows of metals. Expected results include revealing potentials for increasing the resource efficiency of metal flows at the national and international level.

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