



Assessing Global Metal Flows –

METAL RECYCLING OPPORTUNITIES, LIMITS, INFRASTRUCTURE

Due to increasingly complex products metal recycling in the 21st century is becoming a more challenging business. The report of UNEP's International Resource Panel on "Metal Recycling – Opportunities, Limits, Infrastructure" clearly shows that a Product-Centric approach is necessary to promote high material recovery rates. Based on the holistic view of modern multi-material products this approach aims to maximize, by means of economically viable techniques, metals extraction from the complex interlinkages within. These products – analogous to natural minerals – should be regarded as "designed minerals" and technologies as well as infrastructure from primary metallurgy can be adapted and applied accordingly.

Recycling economics, technology and legislation

Economic incentives should be pushed by policy and legislation to promote the use of Best Available Techniques (BAT). There is a need to create a global level playing field in the recycling sector through the internalization of external costs. The agreement on common international standards will help stakeholders in the recycling system to operate on a best-practice basis, taking into account social, environmental, technological and economic considerations. For some minor metals, effective international arrangements will be required to facilitate transparent cross-border transportation to large central plants, which operate according to BAT standards.

Adaptive infrastructure and technology

Given the complex and changing nature of modern End-of-Life (EoL) products adaptive recycling infrastructure and technology are keys to achieving economic success and resource efficiency. In particular, it is essential to draw on existing metallurgical process knowledge and

infrastructure. Both are available in the primary and secondary metals processing industry, which needs to be preserved and developed according to environmentally sound principles in order to allow for the most resource-efficient recycling.

Collection as part of the recycling system

Collection – positioned at the beginning of every recycling effort – forms a crucial part of the recycling system. In order to foster collection and hence overall End-of-Life recycling rates a suitable infrastructure is necessary. This infrastructure needs to be designed in a way which channels all components into the appropriate pre-processing and recycling routes. Securing delivery to the right facilities in sufficient volumes for economic recycling contributes to enhanced recovery, thereby increasing the revenue generated from waste. This can, in turn, contribute to the financing of the required collection infrastructure – a point which to date remains challenging. Besides finding suitable financing mechanisms, there is the need to raise consumer awareness of recycling, which also plays an important role.



Design for resource efficiency (DfRE)

The Product-Centric approach enables a complex design for resource efficiency (DfRE). Capturing the multi-material nature of modern EoL products requires a life cycle perspective linked to comprehensive engineering process design and simulation models. These tools capture the effects of design/material choices and linkages in products based on how they break up and separate in recycling processes. This helps to avoid designs that hinder recycling and also contributes to the optimized recovery of all elements. Besides promoting such recycling-friendly product design, policy should assist the required adoption of life cycle management (LCM) by manufacturers.

Systemic material efficiency targets

Existing mass-based End-of-Life recycling rates are often counterproductive in terms of the recovery of specialty metals embedded in complex products as they only take into account the quantity, not the quality of the materials. Instead, economics-based and environmentally benign key performance indicators (KPI) should be determined based on interactive simulation tools which take into account the relevance of specialty metals despite their low volumes. These should then be used to identify BAT recycling processes.

Education, Information and R & D

Better education, information and R & D are global key challenges when striving to enhance the overall recycling rates of metals. Multidisciplinary systemic education approaches based on a thorough understanding of engineering, physics, chemistry as well as social sciences, economics and law are required which use exist-

ing tools and knowledge gathered from primary metallurgy. Analogous to the quantification of natural orebodies, the urban orebody – the stock of “designed minerals” in society – needs to be mapped to support decisions on R & D activities and investments in metal recycling.

Outlook

Modern multi-material products pose a challenge to recycling so that the recovery rates, especially of specialty metals, are still low. In order to promote resource efficiency this challenge should be met by adopting a Product-Centric approach and jointly addressed by policy and legislation, research and education, and the metallurgical industry. Besides providing its long-standing metallurgical knowledge the latter should contribute by fostering R & D and investment. There is a critical demand for research on the quantification of the urban orebody and its mineralogy. Thorough understanding of (metallurgical) process engineering, separation physics and process economics forms an important educational prerequisite. Policy and legislation should promote the use of environmentally sound Best Available Techniques (BAT). This requires the creation of a global level playing field, recycling-friendly products based on Design for resource efficiency (DfRE) as well as the setting of realistic recycling targets. Decision-making should rely on the use of simulation tools for which more detailed information on the material composition of products is necessary.

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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 national and international levels.