
Multilevel Cycle of Anthropogenic Copper

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A comprehensive contemporary cycle for stocks and flows of copper is characterized and presented, incorporating information on extraction, processing, fabrication and manufacturing, use, discard, recycling, final disposal, and dissipation. The analysis is performed on an annual basis, ca. 1994, at three discrete governmental unit levels—56 countries or country groups that together comprise essentially all global anthropogenic copper stocks and flows, nine world regions, and the planet as a whole. Cycles for all of these are presented and discussed, and a “best estimate” global copper cycle is constructed to resolve aggregation discrepancies. Among the most interesting results are (1) transformation rates and recycling rates in apparently similar national economies differ by factors of two or more (country level); (2) the discard flows that have the greatest potential for copper recycling are those with low magnitude flows but high copper concentrations—electronics, electrical equipment, and vehicles (regional level); (3) worldwide, about 53% of the copper that was discarded in various forms was recovered and reused or recycled (global level); (4) the highest rate of transfer of discarded copper to repositories is into landfills, but the annual amount of copper deposited in mine tailings is nearly as high (global level); and (5) nearly 30% of copper mining occurred merely to replace copper that was discarded. The results provide a framework for similar studies of other anthropogenic resource cycles as well as a basis for supplementary studies in resource stocks, industrial resource utilization, waste management, industrial economics, and environmental impacts.

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