

Study: Not Enough Metals in Earth to Meet Global Demand

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Researchers studying supplies of copper, zinc and other metals have determined that these finite resources, even if recycled, may not meet the needs of the global population forever, according to a study published in the *Proceedings of the National Academy of Sciences*.

According to the study, even the full extraction of metals from the Earth's crust and extensive recycling programs may not meet future demand if all nations begin to use the same services enjoyed in developed nations.

The researchers – Robert Gordon and Thomas Graedel of Yale University and Marlen Bertram of the Organisation of European Aluminum Refiners – suggest that the environmental and social consequences of metals depletion became clear from studies of metal stocks—in the Earth, in use by people and lost in landfills—instead of tracking the flow of metal through the economy in a given time and region.

“There is a direct relation between requisite stock, standard of living and technology in use at a given time,” said Gordon, professor of geology and geophysics. “We offer a different approach to studying use of finite resources—one that is more directly related to environmental concerns than are the discussions found in the economics literature.”

Using copper stocks in North America as a starting point, the researchers tracked the evolution of copper mining, use and loss during the 20th century. Then the researchers applied their findings and additional data to an estimate of global demand for copper and other metals if all nations were fully developed and used modern technologies.

According to the study, titled “Metal Stocks and Sustainability,” all of the copper in ore, plus all of the copper currently in use, would be required to bring the world to the level of the developed

nations for power transmission, construction and other services and products that depend on copper.

For the entire globe, the researchers estimate that 26 percent of extractable copper in the Earth's crust is now lost in non-recycled wastes; for zinc, it is 19 percent. Current prices do not reflect those losses because supplies are still large enough to meet demand, and new methods have helped mines produce material more efficiently.

The study suggests these metals are not at risk of depletion in the immediate future. However, the researchers believe scarce metals, such as platinum, risk depletion in this century because there is no suitable substitute for use in devices such as catalytic converters and hydrogen fuel cells. They also found that, for many metals, the average rate of use per person continues to rise. As a result, the report says, even the more plentiful metals may face similar depletion risks in the future.

“This is looking at recycling on a broader scale,” said Cynthia Ekstein, the National Science Foundation (NSF) officer who oversees the Yale award. “This is looking at the metal lifecycle from cradle to grave.”

The research emerged from collaboration among researchers funded by the NSF Biocomplexity in the Environment—Materials Use: Science, Engineering and Society program.

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