New study raises questions about sustainability of metal resources

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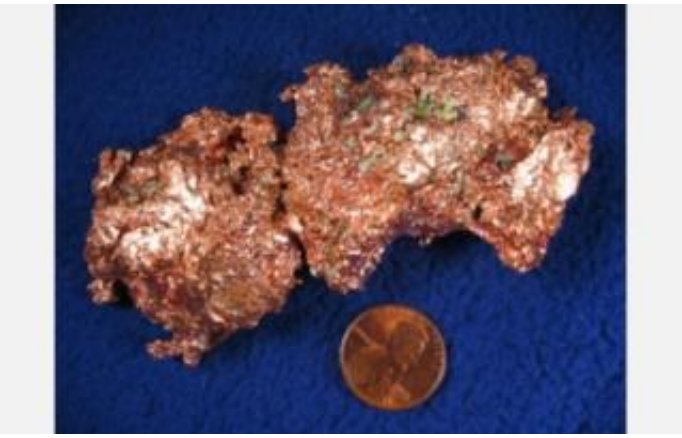

This image shows copper in ore. The penny was once composed mainly of copper, but since 1982 the United States Mint has made pennies from copper-plated zinc. Credit: USGS

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

The researchers suggest the environmental and social consequences of metals depletion become clearer from studies metal stocks--those in the Earth, in use serving people and lost in landfills--instead of tracking the

flow of metal through the economy in a given time and region.

Yale University researchers Robert Gordon and Thomas Graedel and their colleague Marlen Bertram of the Organisation of European Aluminum Refiners report their findings in the Jan. 17, 2006, *Proceedings of the National Academy of Sciences*.

"There is a direct relation between requisite stock, standard of living, and technology in use at a given time," said Gordon. "We therefore 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, 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, that number is 19 percent. Prices do not reflect those losses because supplies are still large enough to meet demands and new methods have helped mines produce ever more material. So, the study suggests these metals are not at risk of depletion in the immediate future.

However, the researchers believe scarce metals, such as platinum, face depletion risks this century because of the lack of suitable substitutes in

such devices as catalytic converters and hydrogen fuel cells. The researchers also found that for many metals, the average rate of usage 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 NSF officer who oversees the Yale award. "This is looking at the metal lifecycle from cradle to grave."

The research emerged from a collaboration among researchers funded by National Science Foundation (NSF) Biocomplexity in the Environment - Materials Use: Science, Engineering and Society (BE - MUSES) program. The program task integrated, multidisciplinary teams with solving problems that transcend single fields of research.

The recent study demanded collaboration between experts in metallurgy, economics, industrial ecology and international studies. "You don't get much more interdisciplinary than this," said Gordon. "This would have been impossible with traditional, individual research projects."

Despite the far-reaching effort, specific, accurate global numbers are difficult to determine. The researchers hope that while the study may not establish definite answers, it will lead to new ways of looking at resource questions.

Source: NSF