Yale researchers call for specialty metals recycling

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An international policy is needed for recycling scarce specialty metals that are critical in the production of consumer goods, according to Yale researchers in *Science*.

"A recycling rate of zero for specialty metals is alarming when we consider that their use is growing quickly," said co-author Barbara Reck, a research scientist at the Yale School of Forestry & Environmental Studies.

Specialty metals, which include rare earth elements such as indium, gallium and germanium, account for more than 30 of the 60 metals in the periodic table. Because they are used in small amounts for very precise technological purposes, such as red phosphors, high-strength magnets, thin-film solar cells and computer chips, recovery can be so technologically and economically challenging that the attempt is seldom made.

"Specialty metals are used in products in only small amounts, but their value typically does not provide enough incentive to invest in a complicated recovery process. Also, the technology to do so is untested," said Thomas Graedel, the study's other co-author and Clifton R. Musser Professor of Industrial Ecology.

The researchers said improved design for recycling, deposits on consumer goods, recycling targets for specialty metals and financial incentives for industry to apply state-of-the-art separation techniques

and recycling technologies would improve metal recycling.

"Metals are infinitely recyclable in principle, but, in practice, recycling is often inefficient or essentially nonexistent because of limits imposed by social behavior, product design, recycling technologies and the thermodynamics of separation," said Reck.

The researchers said that modern technology has produced a conundrum. The more intricate the product and the more diverse the materials it uses, the better it's likely to perform but the more difficult it is to recycle.

The benefit to recycling metals, they said, includes the potential to reduce the extraction of virgin ores, thus extending the life of those resources. The environmental impacts of metal production are reduced substantially when recycled materials, rather than primary materials, are used, and recycling a metal is generally much more energy-efficient than acquiring it from a mine.

"Depending on the metal and the form of scrap, recycling can save as much as a factor of 10 or 20 in energy consumption," Graedel said. "The situation clearly calls for international policy initiatives to minimize the seemingly bizarre situation of spending large amounts of technology, time, energy and money to acquire scarce metals from the mines and then throwing them away after a single use."

The paper, "Challenges in Metal Recycling," can be viewed at http://www.sciencemag.org/content/337/6095/690.full.

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