International Copper Association
Copper Alliance

Copper Recycling

THE IMPORTANCE OF RECYCLING

During the past decade, strong growth in emerging economies, coupled with an increased use of copper for innovative technologies, has led to significantly higher copper demand. The recovery and recycling of copper helps to satisfy this demand and to build a sustainable future for future generations.

COPPER IS 100% RECYCLABLE

Copper is one of the few materials that can be recycled repeatedly without any loss of performance. There is also no difference in the quality of recycled copper (secondary production) and mined copper (primary production), thus they can be used interchangeably.

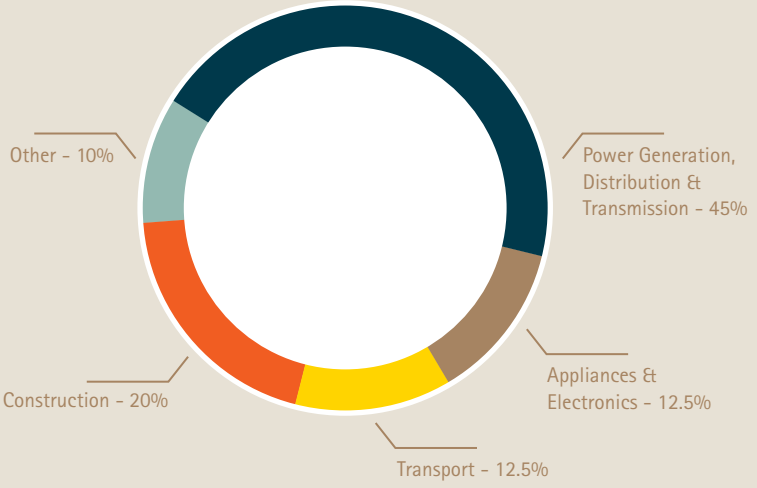
RECYCLING SAVES CO_2 AND ENERGY

Recycling copper is a highly eco-efficient way of reintroducing a valuable material back into the economy. The recycling of copper requires 80 - 90% less energy than primary production. Globally, this saves 40 million tonnes of CO_2 annually, which is equivalent to taking 16 million passenger cars off the road.

In addition to its environmental benefits, the recycling of complex copper scrap (such as electronic waste) drives the recovery of many other metals such as gold, silver, nickel, tin, lead and zinc.

COPPER IN USE

It is estimated that since 1900 two-thirds of the 550 million tonnes of copper produced are still in productive use (Glöser, 2013). Nearly 70 percent of worldwide copper produced is used for electrical/conductivty applications and communications, as shown in Figure 1.



Copper has the highest electrical conductivity of any metal, apart from silver. This property makes copper the material of choice in power generation and transmission (45 percent of use)—delivering electricity safely and efficiently to homes and businesses

Electrical equipment—providing circuitry, wiring and contacts for appliances and consumer electronics accounts for 12.5 percent of copper usage.

The remaining 12.5 percent is used for by the transport sector. The high purity copper wire harness system in a train, car or truck carries the current from the battery throughout the vehicle to equipment such as lights, central locking, on-board computers and satellite navigation systems.

Another 20 percent of all the copper produced is used in buildings—for plumbing, roofing and cladding. Copper provides light, durable maintenance-free structures that are naturally good looking, long lasting and fully recyclable.

The remaining 10 percent is used for coins, sculptures, jewelry, musical instruments, cookware and other consumer goods.

This enormous stock of copper, contained in its diverse range of end uses, and equivalent to around nearly 30 years of mine production, is often referred to as society's "urban mine."

COPPER, THE RECYCLING CHAMPION

Currently, a total of around 8.5 million tonnes of copper per year come from the recycling of "old" scrap (copper contained in end-of-life products) and "new" scrap (generated during production and downstream manufacturing processes). The figure below shows how recycling is a core part of the overall copper value chain.

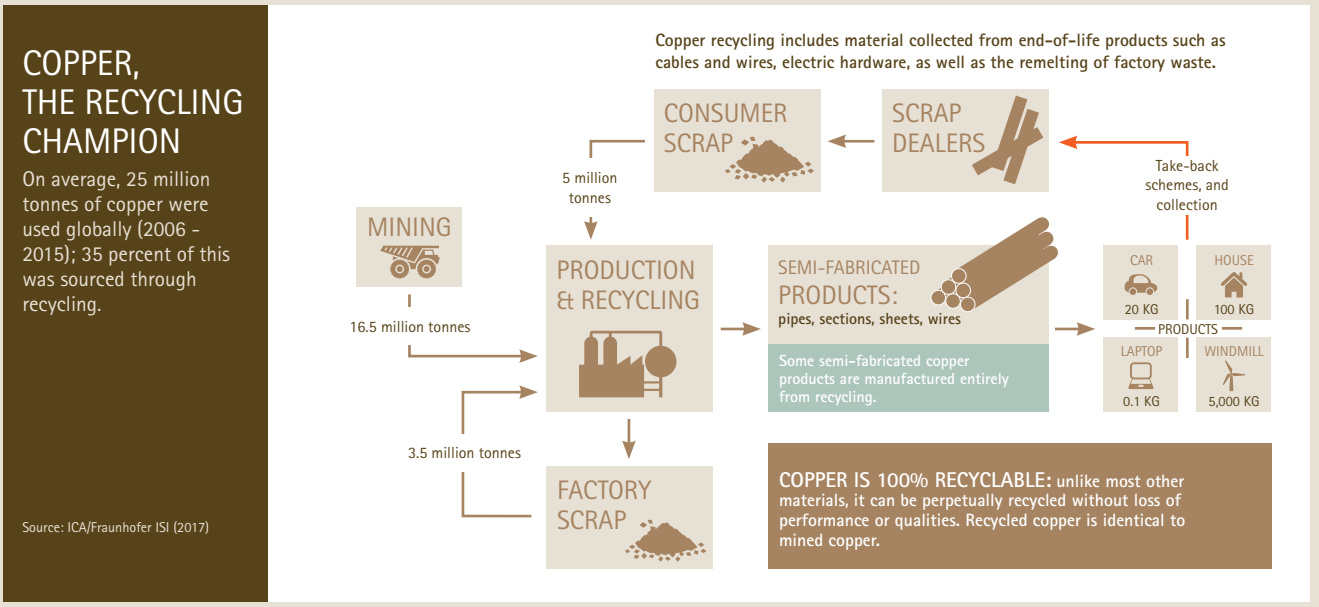


FIGURE 2: Simplified value chain for copper

While a few copper applications result in unrecoverable losses, such as dissipative losses due to abrasion (e.g. automotive brake pads) and copper chemicals used as animal food supplements and fungicides, the majority of uses are part of well-established recovery and take-back schemes.

COPPER FLOW MODEL AND RECYCLING RATES

A comprehensive study of the stocks, flows and recycling rates for copper has been developed by the Fraunhofer Institute. Dynamic models have been developed for the World, China, Japan, EU28, Latin America and North America. They provide detailed information on how much copper is introduced into the economy and how much is used and stored, discarded, and recycled. This complex work has resulted in a much improved understanding of how copper is used and re used by society.

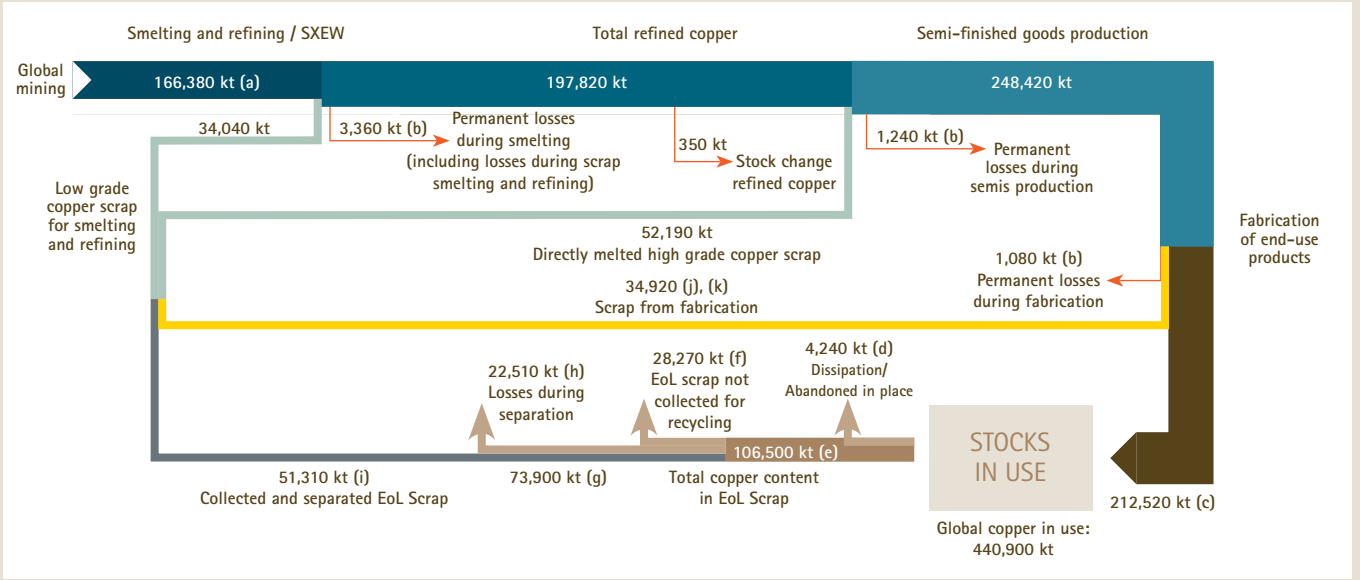


FIGURE 3: Global copper stocks and flows 2006 – 2015 (ICA/Fraunhofer ISI, 2017)

Based on the work of the Fraunhofer Institute, the following global recycling rates for copper can be derived.

Recycling Rate	Definition*	Value (%)**
End-of-Life (EoL) Recycling Rate	EoL RR = $\frac{i}{e}$	50%
End-of-Life (EoL) Collection Rate	EoL CR = $\frac{g}{e}$	70%
End-of-Life (EoL) Processing Rate	EoL PR = $\frac{i}{g}$	70%
Overall Recycling Efficiency Rate	ORER = $\frac{i + k}{e + j}$	60%
Recycling Input Rate	RIR = $\frac{i + k}{a + i + k}$	35%

TABLE 1:
Copper recycling rates (ICA/Fraunhofer ISI, 2017)

** The recycling rates are those developed by Eurometaux and Eurofer (Eurometaux, 2012).*

*** These rounded values are derived for the period 2006 - 2015.*

SUMMARY

Copper is one of the few materials that can be recycled repeatedly without any loss of performance. As well as helping to satisfy the annual demand for copper, recycling conserves valuable natural resources, saves energy and reduces CO_2 emissions.

Copper recycling contributes to a progressive move toward a more circular economy. However, the loop cannot be completely closed for two reasons. First, demand will continue to increase due to population growth, product innovation and economic development. Second, in most applications, copper stays in use for decades before being ready to recycle and use again. Consequently, the growing demand for copper will require a combination of raw materials coming from mines (primary copper), as well as from recycled materials (secondary copper). During the last decade about 35 percent of annual copper use came from recycled sources.

Sitting at end of the recycling value chain, the copper industry plays crucial role by "closing the loop" and is constantly investing and innovating to ensure the circular management of metals. However it is more difficult to collect and reprocess increasingly complex materials containing copper such as electronic scrap. Therefore endeavors supporting recycling can be implemented in new product design to facilitate end of life recovery and the industrial recycling processes to increase overall yields. In addition, regulatory policies must continue to encourage recovery and recycling, both at the industry level and by the individual citizen.

DISCLAIMER

This document, developed to provide information on copper recycling, has been prepared from publically available information. Its purpose is to provide readers with information to make independent business decisions.

ANNEX: REFERENCES

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