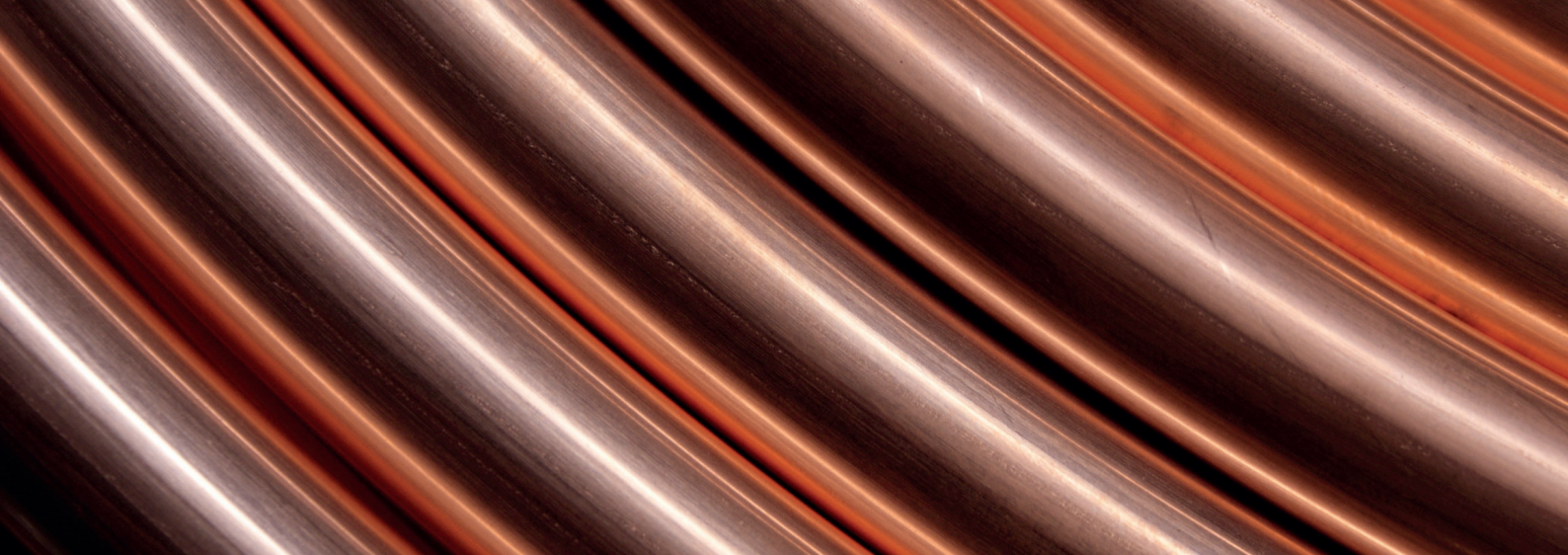




European
Copper Institute
Copper Alliance

The environmental profile of copper products

A 'cradle-to-gate' life-cycle assessment for copper tube, sheet and wire produced in Europe



Copper's contribution to sustainable development

Copper has never been more important for the sustainable growth of modern society. Copper based products improve the economic efficiency and environmental performance of multiple applications across the energy, healthcare, IT, industrial, transportation and building sectors.

Improving the environmental performance of products, along with enhancing sustainability throughout the supply chain, have gained significantly in importance in recent years, both for consumers and industries. In parallel, EU initiatives, such as the Sustainable Consumption and Production Action Plan, foster greater resource efficiency and the commercialisation of more environmentally friendly products.

highly representative environmental profile of the European market place. A critical review by external experts has confirmed the high quality, consistency and correctness of the results. Compared to previous studies, this update includes a much larger geographical coverage, as well as actual mining data, versus technology based models.



The copper industry is at the forefront of industries committed to reducing the environmental impact of its operations. Today, one third of the energy consumption of modern European copper manufacturing is used to operate environmental protection measures.

Responding to requests from end-users and regulators, along with the industry's own sustainable development goals, the copper industry has conducted detailed life cycle assessments (LCA) on the production of copper metal and the leading semi-finished copper products (tube, wire and sheet).

This assessment, which covers around 90% of the EU's production of both copper metal and copper products, provides a





Our approach covers the extraction of ore, at the mine, through to the manufacture of semi-finished copper products

Using methodologies clearly defined by the international standard ISO 14040/44, an LCA delivers an environmental profile across the production, use and end-of-life of a product. For metals, it includes all aspects of ore extraction, the production of other raw materials, energy supply and the production of the metal itself. It further includes the use phase, plus the recycling or disposal at the end of the product's life. As such, it captures the full impact of the so-called "cradle-to-grave" approach.

An LCA shows where the greatest environmental impacts occur and where improvement actions would deliver the most benefits.

This report for copper metal and semi-fabricated copper products covers the so-called "cradle-to-gate" assessment. It includes all major production steps, starting from the extraction of the copper ore at the mine (the cradle), through to the manufacture of semi-finished products,

such as tube, sheet and wire, from the factory (the gate).

Whilst this study is based on the "cradle-to-gate" assessment, many of the benefits to society derived from copper will be found during the downstream use phase.

Using these high quality datasets, industry sectors further down the value-chain, such as building construction and automotive, can develop the environmental profiles of their own products and installed systems. They can also compare the impact of using copper versus other materials offering potentially similar performance.

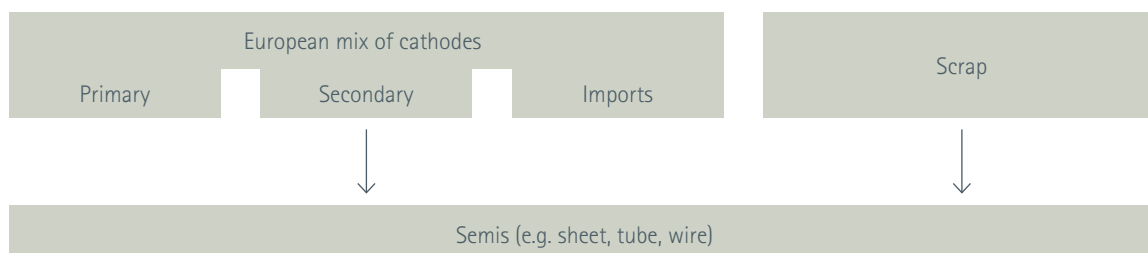
Environmental profile of copper metal

Copper is delivered into the front end of the value chain in the form of a cathode. Its environmental impact has been quantified for the most asked for categories of global warming potential (GWP) and primary energy demand (PED).

Only about 20% of the total impact arises from EU copper production sites. These are directly influenced by technology, local authority permit requirements and a company's own standards. Impacts are also influenced by the source of energy supplying the production site. Electricity produced from coal results in a higher environmental burden versus a grid mix largely reliant on renewable sources. This is largely beyond the control of the local copper producer.

The greatest influence comes from the raw materials used (ores, concentrates and scrap). Copper concentrations in naturally occurring ores are typically between 0.2 and 2.5%. Geologically, copper is associated with other valuable and precious metals, such as molybdenum, silver and gold (multi-metal mines). Since their natural concentrations are much lower, the ore needs careful treatment to maximise recovery yields. Modern mining techniques require less energy than in the past, making the recovery of small amounts of metal

Material inputs for semi-fabricated products





more viable. Energy use is optimised across the upstream milling and concentrate production processes in order to reduce losses and improve yields, particularly for rare earth metals.

After mining and flotation, the remaining minerals and tailings are used, either to re-fill the underground mine openings, or are covered and landscaped. Waste rock normally contains so few minerals that it can be used in other applications, such as land-fill, ballast and road construction. The final slags from copper smelters are inert and used for a variety of construction and sandblasting applications.

The metal produced from ores and concentrates is referred to as primary copper production. Metal can also be produced by recycling the scrap generated during the operations of the downstream value chain, as well as from end-of-life products. Europe is one of the few regions where producers, typically referred to as secondary smelter/refiners, produce copper cathodes out of 100% recycled scrap. While this is usually referred to as secondary copper, it has the same performance properties as primary material.

Environmental profiles of copper wire, sheet and tube

In addition to the impacts of the manufacturing process itself, the life cycle of a semi-fabricated product is a function of the mix of cathodes and scrap used. For example, once the plastic insulation has been removed, the copper conductor inside

a wire or cable can simply be re-melted for use.

Generally speaking, wire products are manufactured from cathodes because of the very high purity specifications needed to deliver high electrical conductivity.

In the manufacture of tube and sheet products, the required end-use performance can still be achieved through the use of high percentages of scrap. This results in these products having lower energy demands and global warming potentials compared to the production of wire.

Since many copper applications have very long lifetimes, the annual amount of scrap available is approximately equal to the production levels of 20 - 50 years ago. The continuous increase in global copper usage therefore continues to require very significant quantities of primary material. However, what is clear is that the European industry is able to recycle all of the material available to it at the factory gate.

Conclusions from the study

Copper mines are multi-metal mines

Low, naturally occurring levels of metals require modern technology and relatively energy intensive processing to separate metals and to optimise yields.

Dominant production stages

The first stage ore extraction and processing are the main contributors to the life cycle impacts.

Copper sources of supply

Both the production of metal and semi-fabricated copper products include significant amounts of scrap. Ensuring that sufficient copper will be available to meet society's future needs will require increased levels of recovery and recycling, as well as substantial investments in primary production.

Copper semis

Continuous investment in modern equipment is reducing environmental impact across the value chain.

The impacts for individual semi-fabricated products are strongly dependent on the environmental profile of the copper cathode, as well as on the share of copper scrap used in the final production.

Electricity grid mix

The local electricity grid mix, often outside of the control of the metal producer, also has a significant impact.

Companies participating in the LCA study

Antofagasta Minerals
Aurubis AG
Boliden
Codelco
Freeport McMoRan
Grupo Mexico
KGHM
KME Group SpA
Metallo Chimique
Montanwerke Brixlegg
Rio Tinto - KUCC
Sumitomo
Wieland Werke AG
Luvata
Xstrata Copper

Facts & figures

Objectives of the LCA

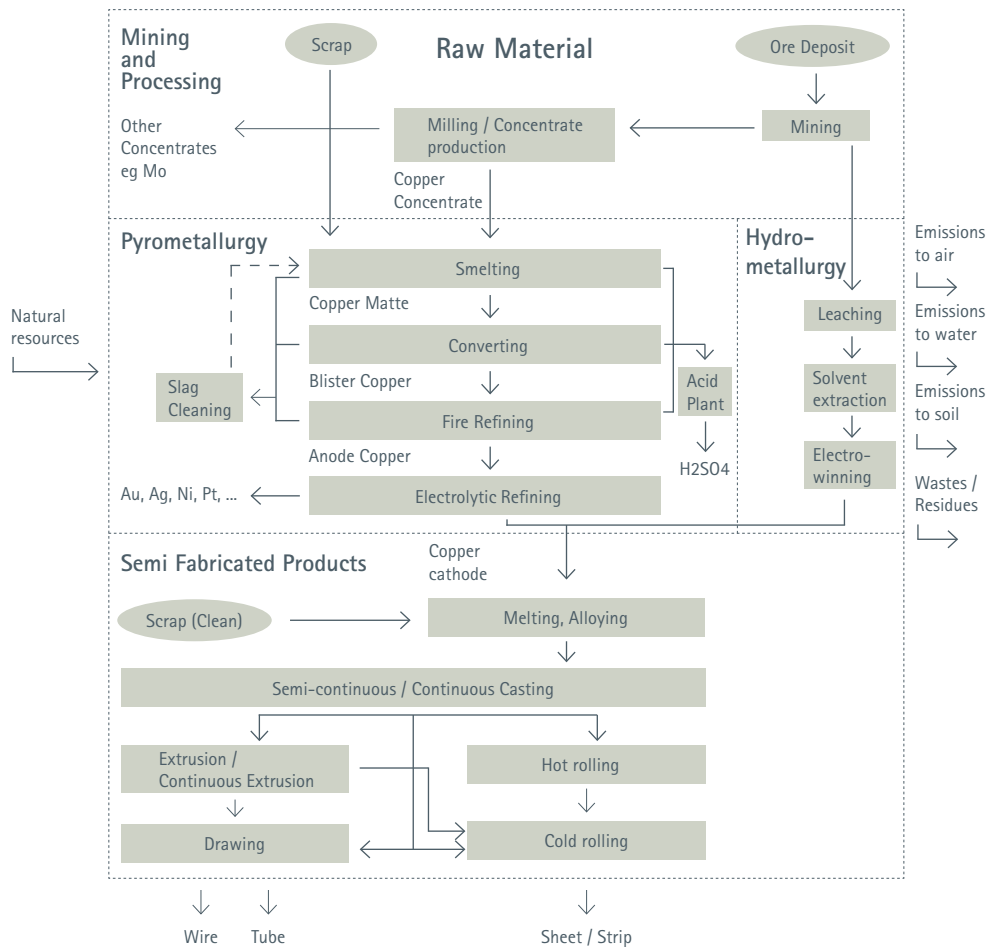
- Provide copper LCA data to downstream industries, Research Institutes and professional associations.
- Meet European Union requirements, e.g. on the European Life Cycle Database initiative and contribute to EU resource efficiency policies.
- Help other organisations understand and communicate correct environmental impacts of copper products in end-use applications.
- Create and communicate a unified, reliable and accurate copper life cycle dataset in collaboration with the EU and the copper industry.
- Provide robust criteria to stakeholders enabling them to make informed material choices.
- Engage in dialogue with the supply chain.

Value of the LCA

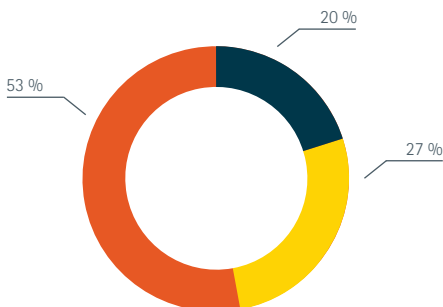
- Greatest environmental impacts within the life cycle are identified allowing the environmental performance of a product to be optimised at an early stage.
- Shifting of impacts from one part of the supply chain to another is avoided.
- Effects of individual materials over the entire product life cycle become visible.
- Communication with stakeholders and political decision makers can be improved.
- Demonstrates industry commitment to sustainable development principles.

LCA results (Global Warming Potential – GWP) according to the sources of impact

1. Those directly controllable at the EU production site
2. Indirect, as a result of local primary energy mix
3. Other indirect emissions occurring upstream in the value chain



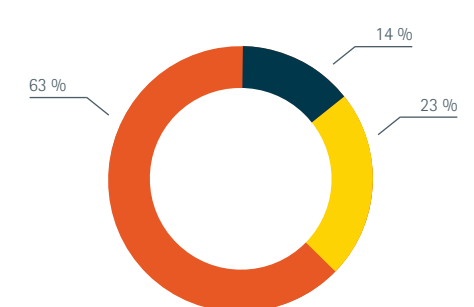
Copper Sheet



Copper Tube



Copper Wire

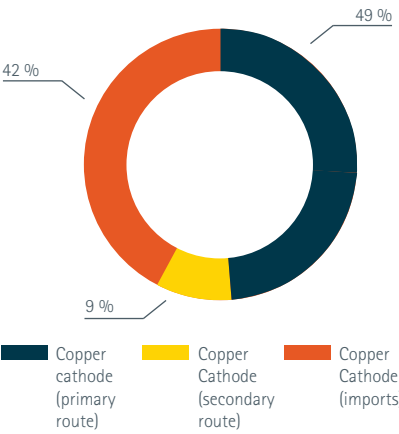


Ref.: WRI / WBCSD GHG Protocol

Copper's contributions to meeting the EU's environmental challenges

Product	Impact Category	Value
SHEET (0.6 mm / 1 m ² / 5.35 kg)	Global Warming Potential	10.6 kg CO ₂ -eg.
	Primary Energy Demand	142.9 MJ
	TUBE (15x1 / 1 m / 0.39 kg)	
TUBE (15x1 / 1 m / 0.39 kg)	Global Warming Potential	0.93 kg CO ₂ -eg.
	Primary Energy Demand	13.04 MJ
	WIRE (1 mm ² / 1 m / 0.00892 kg)	Global Warming Potential
Primary Energy Demand		0.472 MJ

European cathode mix



As the EU places more and more emphasis on the "green technologies" needed to meet its 2020 energy targets, it is increasingly important to understand the life cycles of the underlying raw materials. Designers and engineers continue to explore new ways to build products that are both more resource efficient and deliver higher performance.

LCA is a valuable input to policy making, where both global impacts and macro effects are considered. It provides environmental profiles for potentially competing raw materials and technology solutions. For instance, copper is the best conductor of electricity and heat, after silver, and improves the efficiency and performance of relevant applications. Generally speaking, using more copper saves energy and reduces CO₂ emissions. Copper also improves the operating efficiency of all forms of renewable energies, such as wind turbines, photovoltaic panels, tidal generation and solar thermal systems.

This LCA shows the importance of recycling old scrap as a way to reduce environmental impact. It reinforces the need for more support for local and national recovery and recycling initiatives, with the industry able to recycle all of the material available to it at the factory gate. By doing so, the copper industry can:

- Continue the innovations that will drive EU competitiveness,
- Boost economic growth while reducing energy losses,
- Combat climate change and reduce the environmental impacts of resource consumption.

Cradle to gate/to grave

At the beginning of an LCA study the system boundaries are clearly defined, i.e. which process steps or life cycle phases are included. Cradle to gate covers all of the production steps, from raw materials "in the earth" (the cradle) to finished products from the factories (the gate). A cradle to grave approach goes further by including both the use phase and the end of life of a product.



Find out more on LCA

More detailed information on this study is available on our Life Cycle Competence Centre's website - www.copper-life-cycle.org. The site also provides general information on the most important aspects related to the use of life cycle data and the methodologies used for copper.

This website also provides a link for practitioners to contact our experts.