

Is copper really harmless?

A study on the environmental, social and health impacts of copper along its life cycle, from materials sourcing to recycling.

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Summary

Production

- Economic structure

- Environmental impacts

- Social impacts

- Health impacts

Processing

- Economic structure

- Environmental impacts

- Health Impacts

Usage and end-of-life

- Economic structure

- Environmental impacts

- Health impacts

International regulatory framework

Alternatives

Context and evolution

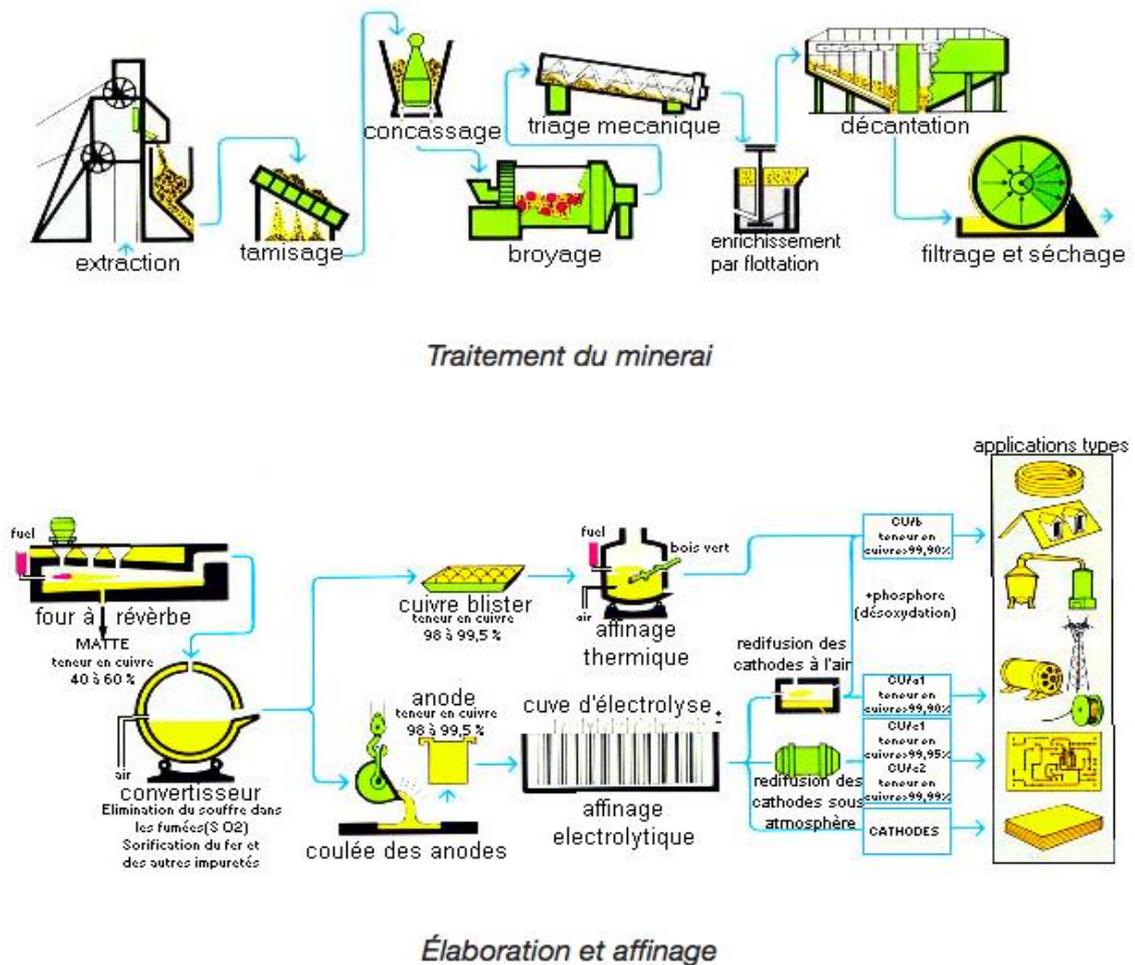


Figure 1. The stages in copper production
Source : European Copper Institute, 2015

- Copper objects dating from 9,000BC have been found in Iraq. It is considered that manufacturing with copper dates from 5,000BC. There is general agreement that the Copper Age preceded the Bronze Age (European Copper Institute).
- The average percentage of copper in the Earth's crust is 0,005% (European Copper Institute).

Though rarely used in its pure state, copper is utilised as a component in the manufacture of numerous everyday objects (telephone, computer and electronic cables, coins, jewellery, kitchen utensils, etc.) In addition, since it is resistant to changes in temperature and weather, it is often used in industry and in construction.

There are a number of stages in the transformation of copper ore into the metal to be utilised (OECD):

- Production: separation of ore from rock (gangue) by mining, grinding and processing to ensure the ore has a uniform character; then transportation to a crusher to break up the ore into small pieces.
- Processing: crushing and sifting of the ore
- Utilisation: distribution in the form of copper concentrate

In antiquity, copper was naturally present in the soil, oceans, lakes and rivers. Nowadays it is primarily available in the earth's crust, in salts containing 30 to 90% of pure copper. The ore concentration is considered rich if it contains at least 1.8% of pure copper (European Copper Institute).

Copper is a natural, bio-persistent element, and as such is not toxic to the environment. Thus, in normal conditions of use, it is recyclable, durable and hygienic.

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Copper production structure

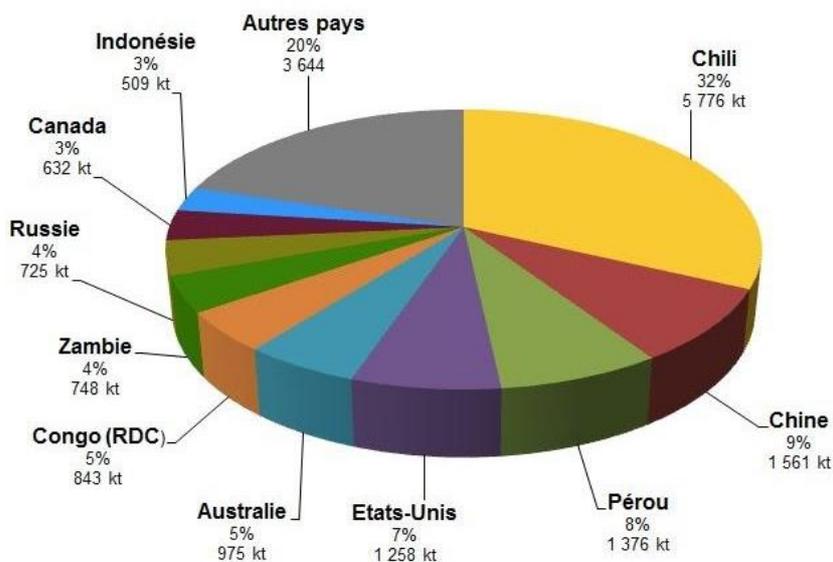


Figure 2. Global mining production in 2013.
Source : International Copper Study Group (ICSG)

- Global copper reserves could be exhausted by 2050 (French Energy and Environment Management Agency, ADEME).
- In the first eight months of 2018, global copper production increased by 3% (ICSG, 2018).
- In 2018, the annual growth rate of copper production was 3% (ICSG, 2018)

According to the ICSG, in 2018, 410,000 additional tonnes of copper were extracted in comparison to 2017. This is mainly due to the general increase in mining production in countries such as Chile, Indonesia and the Democratic Republic of Congo (DRC):

- For example, in Chile, the biggest producer of copper, production increased by 8%. Currently Chile represents 10% of global production.
- In Indonesia, following the ending of a moratorium in certain export sectors in April 2018, copper production increased by 27%.
- In the DRC and in Zambia, the production increase was about 10%.

Large-scale copper mining projects are developing and accelerating throughout the world. For example, ADEME highlights the Oyu Tolgoi mine in South Mongolia which should alone allow the extraction of more than 400,000 tonnes of ore per year (Geldron 2017).

In the light of the projected exhaustion of resources by 2050, new areas for extraction have been considered. According to ADEME, mining in areas of the Arctic and Antarctic as well as in underwater zones of great depths could offer significant potential in terms of copper reserves. However, such areas present extreme weather conditions and/or technological challenges for mining projects as well as presenting new socio-environmental concerns.

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- International Copper Study Group (ICSG). Copper: Preliminary Data for August 2018. Press release 21 November 2018.
- Labbé, Jean-François Les limites physiques de la contribution du recyclage à l'approvisionnement en métaux (The physical limits to supply of metals from recycling). Conference technical report Conference of the SIM [Société de l'industrie minière, Mineral Industry Society] Bordeaux: [s.n.], 2014.
- OECD. Méthodologie pour améliorer les connaissances relatives aux chaînes de transformation de l'industrie minière, étude de cas illustrant les filières de transformation des minerais de cuivre, de fer et d'or. (Methodology to improve understanding of mining industry processing chains: case study of the processing chains for copper, iron and gold ore). Tax and Development Programme, OECD, 2015

Environmental impacts

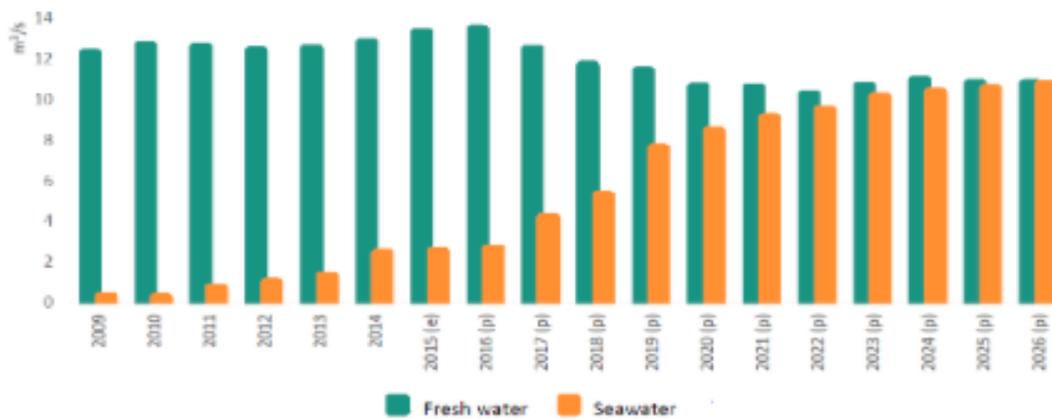


Figure 3. Evolution of water usage in the copper mining sector in Chile.
Source : Cochilco, 2016

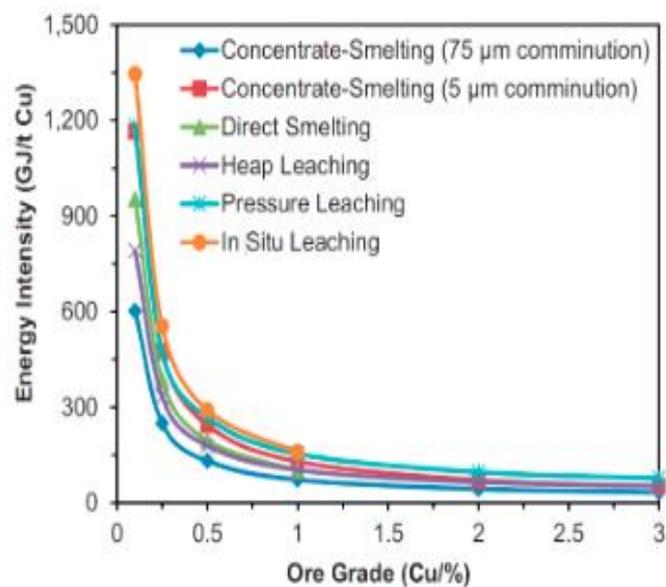


Figure 4. Energy use of copper production in relation to ore grade, and ore grade and processing technology.
Source : Northey et al. 2017

- An 8% increase in copper production in Chile involves a 62% increase in water use (ADEME, 2017).
- Between now and 2050, 2.4% of global energy consumption will be due to copper production, as against 0.3% in 2012 (ADEME, 2017).
- In Canada, for every tonne of copper, on average 99 tonnes of superfluous rock and soil material are extracted (Exploitation Minière, 2017).

Water and electricity are indispensable for copper mining and generate very significant environmental impacts.

The ore grinding and concentration processes represent 70% of the total water consumption along copper's life-cycle. This is particularly problematic because copper mining often takes place in arid, semi-desert or other areas with poor water resources. In Chile, for example, the Ministry of Mines stated in 2016 that in the next 10 years, copper mining would require water consumption at the rate of 20m³ per second, sea water comprising half of this. (Montes, 2016)

Between the mid of the 20th century and 2011, energy use by the whole mining sector (all metals included) has quadrupled. Concerning the copper, processing represents 50% of the production process energy use, when 36% is due to the mining stage (ADEME 2017). Thus, despite current efforts, improvements in energy efficiency will not be enough to compensate for the effects of the lowering of copper ore grade.

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- Northey, Stephen A; Mudd, Gavin; Werner, Tim; Jowitt, Simon; Haque, Nawshad; Yellishetty, Mohan; Weng, Zhehan The exposure of global metal resources to water criticality, scarcity and climate change. Global Environmental Change. Elsevier, 2017. - 44. - pp. 109-124.

Social impacts



*Figure 5. Artisanal copper mine workings in Kapulo, Democratic Republic of the Congo.
Source : Club Unesco-Ntchenko*



Figure 6. The Monywa mine illustrate the economic and social impact of mining on local communities as well as the brutal repression of peaceful demonstrations. Source : Info Birmanie

- The impacts of the 2009 crisis were even felt on mining in Zambia, leading to a lowering of copper prices and massive layoffs (Simpere, 2010).
- In 2005, the year when the European Investment Bank approved its loan to the country, at least 71 miners died in work-related accidents in Zambia.

In 2016, Engineers Without Borders detailed working conditions in artisanal copper mines in the DRC, Peru and Chile, specifically regarding “dust inhalation, long hours of sun exposure, drinking non-potable water” and also transporting heavy loads.

In addition, child labour in copper mines is a frequent phenomenon as for example in the DRC where the majority of children aged 6-17 employed in copper mines acknowledged that they did this work to finance their studies (PACT, 2013).

More broadly, mining production – in copper and beyond - are closely related to socio-political processes, the latter having an impact on the former. For example, during past prolonged strikes of miners in Peru and Chile, copper prices have always increased considerably, as in the case of political upheavals in the DRC.

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- Simpere, Anne-Sophie. Projet Mopani (Zambie) : L'Europe Au Cœur D'un Scandale Minier Rapport De Mission. (Mopani project, Zambia: Europe at the heart of a mining scandal, report of a mission) Les Amis De La Terre France [Friends of the Earth, France]. December 2010. [Online] <http://www.amisdelaterre.org/IMG/pdf/rapportmopani2.pdf>

Health impacts



Figure 7. Inside the copper manufacturing facility in Mulfulira (Zambia) in 2008.

Source : Jean-Claude Coutasse, Divergence Images

- In 2005, at least 71 miners died in work-related accidents in Zambia alone (Simpere, 2010).
- A Zambian miner revealed that the companies employing them « tell us to keep on working where there is no ventilation, as long as production continues... If there is an inspection, they show other parts [where there is ventilation] » (Simpere, 2010).

According to a report published by the NGO, Friends of the Earth, it is often “difficult to obtain precise data on the connections between worker illness and working conditions in mines”. Indeed, available information on the levels of pollution - and more broadly on activities at mining sites - only comes from mining companies.

However, some studies have shown that working conditions are generally inadequate, and workers are often victim of respiratory and digestive diseases as well as articular problems (Engineers without Borders, 2016). In addition, due to the fact that prostitution often occurs close to mines, artisanal copper mining is correlated with contamination from and propagation of sexually transmitted diseases (Tsurukawa, Nicolas et al., 2011).

- Ingénieurs Sans Frontières Systext [Engineers Without Borders Extractive Systems], Etat des lieux des conséquences graves de l'exploitation minière (Inventory of serious effects of mining), 2016 [Online]. http://www.isf-systext.fr/sites/default/files/Livret_ELCG-Exploitation-Miniere_ISF-SystExt_2016_0.pdf
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- Tsurukawa, Nicolas, Siddharth Prakash et Andreas Manhart. Social Impacts of Artisanal Cobalt Mining in Katanga, Democratic Republic of Congo. Report. Oko-Institut E.V. Freiburg, Germany, 2011.

Copper processing structure

	2014	2015	2016	2017	2017	2018	2018			
					Jan-Aug	May	Jun	Jul	Aug	
World Mine Production	18,426	19,149	20,357	20,038	12,991	13,399	1,735	1,702	1,695	1,693
World Mine Capacity	21,547	22,336	23,387	23,859	16,098	16,357	2,111	2,050	2,046	2,054
Mine Capacity Utilization (%)	85.5	85.7	87.0	84.0	80.7	81.9	82.2	83.0	82.9	82.5
Primary Refined Production	18,575	18,897	19,471	19,470	12,779	12,610	1,632	1,584	1,575	1,602
Secondary Refined Production	3,915	3,945	3,866	4,053	2,684	3,005	368	385	379	360
World Refined Production (Secondary+Primary)	22,490	22,843	23,338	23,523	15,463	15,615	2,001	1,970	1,954	1,961
World Refinery Capacity	26,468	26,551	26,863	27,402	18,195	18,454	2,355	2,282	2,361	2,364
Refineries Capacity Utilization (%)	85.0	86.0	86.9	85.8	85.0	84.6	84.9	86.3	82.8	83.0
World Refined Usage 1/	22,927	23,081	23,605	23,789	15,562	15,874	2,067	1,997	2,038	1,993
World Refined Stocks End of Period	1,334	1,505	1,375	1,383	1,418	1,396	1,646	1,583	1,462	1,396
Period Stock Change	10	171	-130	7	43	13	13	-64	-120	-67
Refined Balance 2/	-436	-239	-267	-266	-98	-259	-66	-27	-84	-31
Seasonally Adjusted Refined Balance 3/					-113	-283	-16	10	-88	-147
Refined Balance Adjusted for Chinese bonded stock change 4/	-460	-342	-255	-264	-50	-304	-56	-30	-96	-64

Figure 8. Refined Copper Usage and Supply Trends (2014-2018).
Source : ICSG

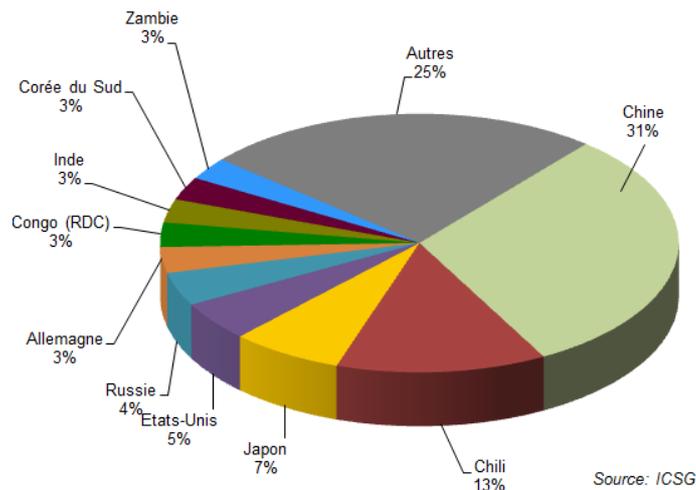


Figure 9. Production of refined copper, by country, in 2013.
Source : ICSG

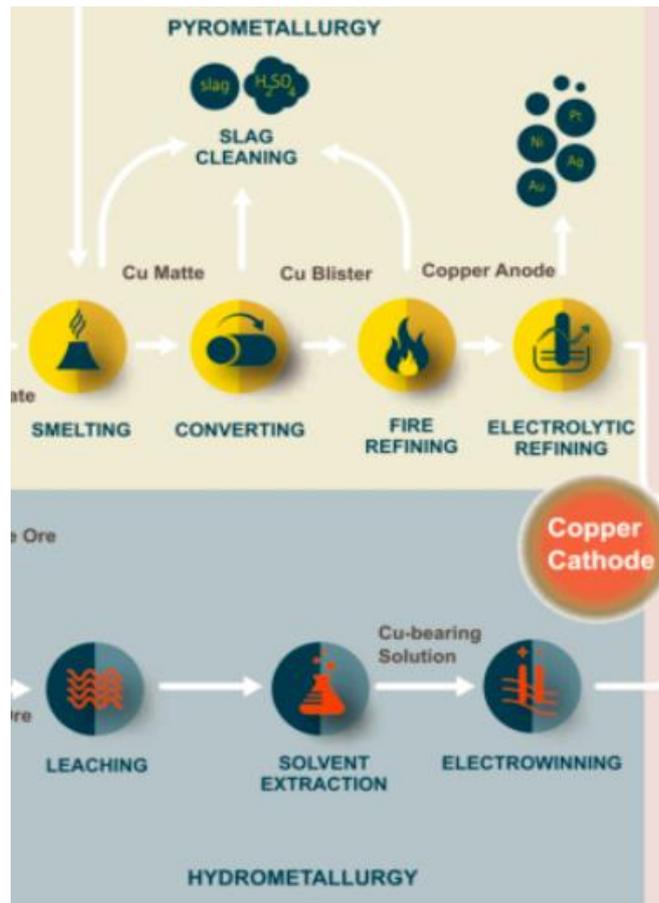


Figure 10. Stages in the processing and purification of copper.
 Source : Copper Alliance, Copyright ECI ©2012

- In 2016, the 28 countries of the EU produced 2.2 million tonnes of refined copper, representing 9.4% of global production (ICSG, 2016)
- Of the copper ore purchased by European refineries, 55% is supplied by European mines (ICSG 2016).
- Approximately 10,000 staff are employed by 6 companies in a dozen European refineries (European Copper Institute).

After mining, the raw ore which contains 1% to 6% of copper goes through a purification process which consists of several stages (Lerat, 1960):

- Separation of the mineral components of copper through grinding, washing and flotation. At the end of this stage, the ore concentrate contains 30%-35% of copper.
- Metallurgy treatment of the concentrate, either using a dry method (pyrometallurgy) or a wet method (hydrometallurgy).
 - In the dry method, the ore is heated to its melting point in a smelter. It is then transported to a refinery. This enables to purify the metal which contains a copper content of more than 99.5%.
 - In the wet method, the ore is dissolved in a solution of sulphuric acid. The ore is then purified using various techniques (cementation, precipitation, electrolysis) and the obtained metal is sent to the refinery.
- Electrolysis for refining

Europe represents 10% of global production of refined copper (ICSG 2016). The principal sites of processing in Europe are found in Germany, Poland, Spain, Sweden and Finland. In these countries, 50% of the raw mineral is sourced from the international market, the rest being sourced directly from European mines.

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Environmental impacts

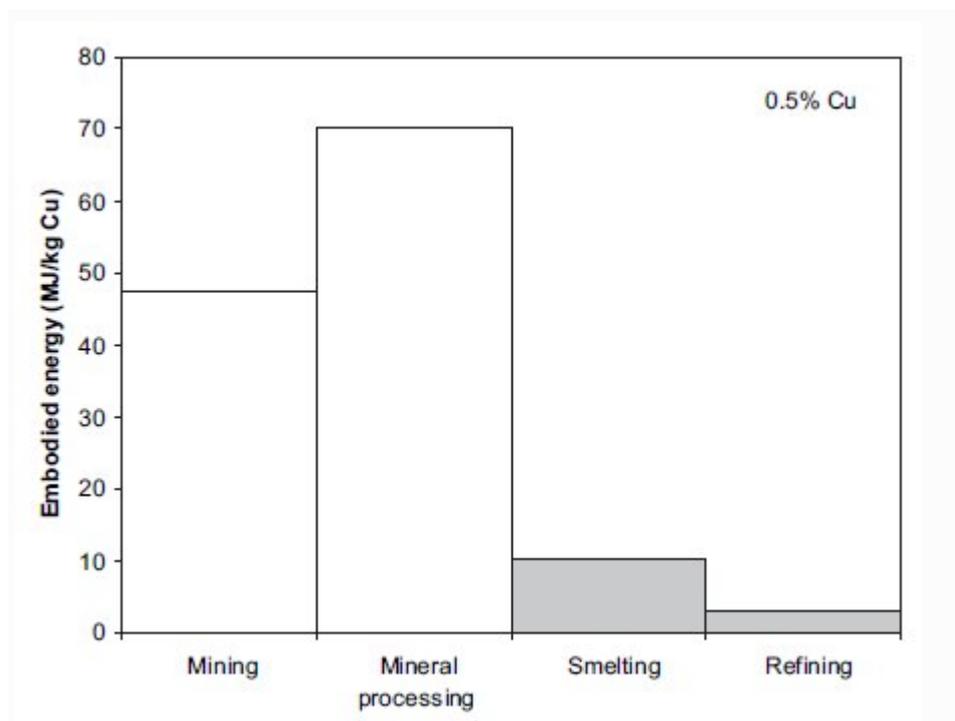


Figure 11. Amount of energy involved in each phase of copper production by pyrometallurgy, for an ore concentration of 0.5%. Source : CNRS, 2014

- There are several waste products generated from the physical and chemical separation processes of copper enrichment. These include rock waste, residues, leaching materials and leaching waste materials (Environment Law Alliance Worldwide, 2010)
- In 2005, the refinery of Grandpuits in Seine et Marne was producing 262kg of copper per year (IREP, 2007).

The processing stages of copper ore which are necessary for its purification generate significant environmental impact. Waste products in solid, liquid and gaseous form, are generated each year by copper ore processing with important negative impacts on land, water and other resources, and as a result also on human health.

Many metal pollutants derive from copper processing industries, especially heavy metals, arsenic and sulphur which emanate from the fumes of industrial copper smelters and increase air pollution (Bril and Bollinger, 2006). For example, in France in 2002, 18 tonnes of arsenic were emitted by copper processing. In Northern Chile, a case study carried out by OECD in 2005 in several towns showed that 600 tonnes of sulphur dioxide were emitted per tonne of copper produced (OECD, 2005). In addition, sulphur and arsenic are emitted by copper smelters during processing.

- EcolInfo, *l'Energie des métaux (Metals and energy)* [Online]. <https://ecoinfo.cnrs.fr/2014/09/03/2-lenergie-des-metaux/>
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- Futura Sciences, *L'enjeu Du Cuivre (The copper issue)* August 09, 2005. [Online]. <https://www.futura-sciences.com/sciences/actualites/physique-enjeu-cuivre-6872/>.
- Hubert Bril, Jean-Claude Bollinger. *Comprendre les pollutions par les métaux (Understanding metal pollution)*. L'Actualité Chimique, Société chimique de France, 2006, 298, pp.54-62
- OECD, *OECD Environmental Performance Reviews: – Chile*, June 2005 [Online]. <http://www.oecd.org/publications/oecd-environmental-performance-reviews-chile-2016-9789264252615-en.htm>

Health impacts



Figure 12. Inside a copper refinery of the Codelco Ventanas company, in the north-west of Santiago, Chile.
Source : Rodrigo Garrido/Reuters (Le Monde)

- Exposure to silica dust whether in underground deposits or in crushing facilities can be a factor leading to the development of silicosis. Silica dust particles enter the respiratory system, resulting in progressive deterioration of lung tissue (Vergara, 2014)
- 2 groups of people are particularly susceptible to copper toxicity: those with a deficit in an enzyme of the red blood cells, and those suffering from Wilson's Disease (Barceloux, 1999).

The International Labour Organization (ILO) has taken a special interest in bringing to light the health consequences of the non-ferrous metal industries. Among them, copper is signalled out as being particularly harmful. Indeed, the ILO stresses that short-term exposure to copper fumes can lead to severe flu-like poisoning, "characterised by fever, trembling, muscular pain and vomiting" The symptoms can manifest themselves within just 24 hours. On the long-term, the ILO also explains that such exposure can result in "nausea, vomiting, anorexia and greenish discolouration of the skin and hair".

Protection against these types of exposure is difficult to implement, because copper fumes and dust can easily be absorbed by ingestion and inhalation. Copper dust acts as an irritant to the mucous membranes and the respiratory passages. During copper processing, workers are continually exposed to toxic gases and heavily polluted air. This increases the number of premature deaths and the chance of acquiring a cardiorespiratory disease. However, if patients manage to recover, there seem to be no residual effects on health from copper poisoning. (International Labour Office, Geneva, 2013).

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- Vergara, Angela. *Légiférer sur les maladies professionnelles au Chili au XX^e siècle : les mineurs du cuivre entre l'État et le patronat* <http://books.openedition.org/septentrion/1808> (*Legislating for work-related illnesses in Chile in the 20th century: miners between the State and the employers*) in "Santé et travail à la mine : xix^e-xx^e siècle" ("Health and work in the mines") [Online]. Villeneuve d'Ascq : Presses universitaires du Septentrion, 2014 (Accessed 24 December 2018). [Online]. <http://books.openedition.org/septentrion/1808>>. ISBN : 9782757414255. DOI : 10.4000/books.septentrion.1808.

Copper consumption structure

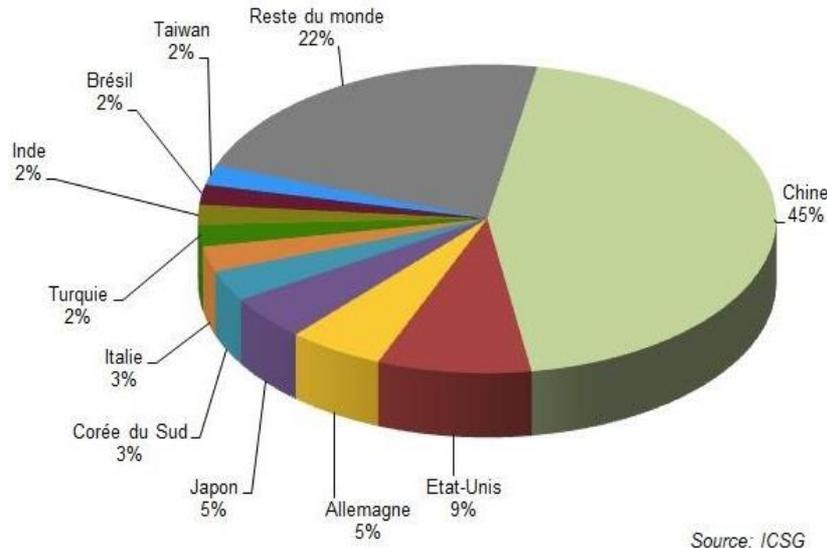


Figure 13. Global consumption of refined copper in 2013. Source : ICSG

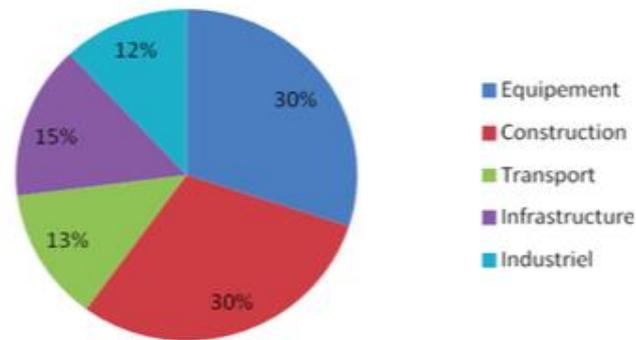
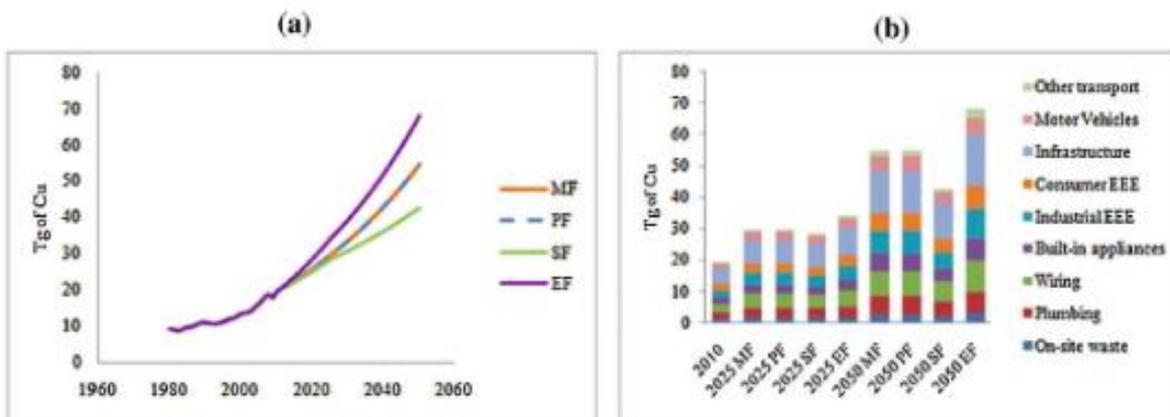


Figure 14. Utilisation by sector in 2012.



Source : ICSG, 2012

Figure 15. Global demand (a) and use distribution of copper in 2010 (b). Source : Graedel et al., 2016

- In 2016, global consumption of copper reached 23.43 million tonnes (ICSG, 2016)
- In 2050, the annual consumption of copper is expected to be around 40 to 70 million tonnes, i.e., 2 to 3 times the current consumption (Graedel et al., 2016).

According to a study by the French National Institute for Industrial Environment and Risks (INERIS), the great majority of copper is utilised in the construction sector and in equipment. The next biggest users are the infrastructure and transport sectors. Lastly, copper is also used in the electrical and electronic sectors and in agriculture.

The largest market is China which consumes more than half of refined copper consumed globally. This is due to the recent urbanisation of China and the significance of its industrial electronic and electrical sector. Europe represented 20% of global demand for copper in 2012 (and France 2-3% - Vignes et al., 2013).

The ICSG estimates that there was a 2% increase in the global level of refined copper used between January and April 2018. Again, the principle consumer was China whose consumption of copper increased by 4.5% over the same period, underpinned by an increase of nearly 15% in imported copper. Among the other main consumers of copper, demand increased in India, Japan and the EU but decreased in Taiwan and South Korea. In the United States, demand remained constant.

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Environmental impacts

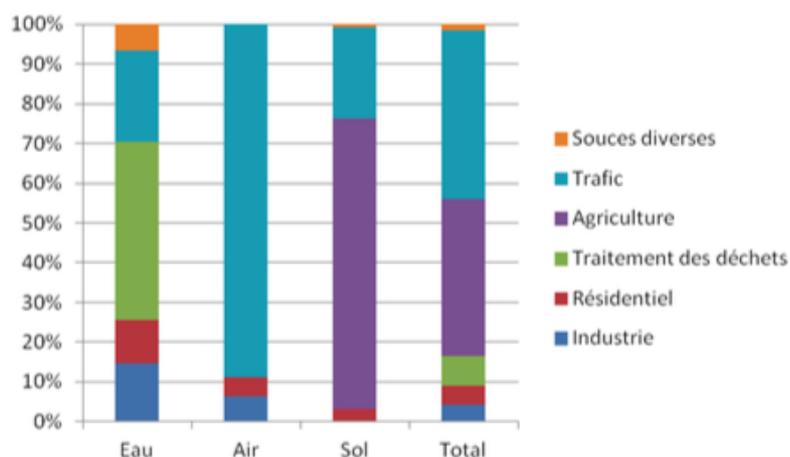


Figure 16. Distribution of copper emissions by environmental context and by emissions source in the EU in 2008, according to the European Copper Institute.
Source : INERIS, 2015

Base de données	IREP					E-PRTR	
	France					France	UE 27
Emissions de cuivre et ses composés	2008	2009	2010	2011	2012	2011	2011
Air (kg/an)	14 849	14 821	11 263	14 128	8 303	14 100	118 000
Eau total (kg/an)	44 543	61 067	64 839	36 865	35 956	31 800	297 000
dont eau direct (kg/an)	37 179	53 565	59 179	31 824	32 821	n.d.	n.d.
dont eau indirect (kg/an)	7 364	7 502	5 660	5 041	3 135	n.d.	n.d.
Sol (kg/an)	96 614	75 968	75 438	56 303	82 032	28 100	31 400

n. d. : non défini

Figure 17. Table of emissions of copper and copper compounds in the environment, according to the French register of pollutant emissions (IREP) and the European Pollutant and Transfer Register (E-PRTR).
Source : INERIS, 2015

- 14% of copper industry installations alone may potentially represent a risk by virtue of an inadequate water treatment system (European Commission, 2009)
- In 2011, of the total declared EU copper emissions into soil, water and air, France's emissions represented respectively 90%, 11% and 12% (INERIS, 2015).
- According to BASOL (a database produced under the aegis of the French Ecology Ministry) in 2014, 1127 localities in France were polluted (or potentially polluted) by copper.

Copper use causes anthropogenic emissions in the environment (linked to human activity). In France and at a European level such discharge are controlled and logged using the BASOL, IREP and the E-PRTR databases. According to the European Pollutant and Transfer Register (E-PRTR), of European countries France has among the highest rates of copper emissions into soil, water and air, its emissions having almost doubled in the past 5 years.

According to the Interprofessional Technical Centre for Studies on Air Pollution (CITEPA), copper emissions mainly derive from catalysed diesel cars (26%) and from rail transport (24%). The emissions are caused by brake pad wear and overhead line wear.

These emissions, once dispersed in the soil by natural or human means, are not destroyed, but build up in plants and animals. This explains why there is such poor diversity of flora around copper-emitting industrial sites. Plants have little chance of survival in a soil rich in copper. In this form, copper represents a real danger to agricultural land.

However, on 27 November 2018, despite the warnings of the European Food Safety Authority (EFSA) and the European Chemicals Agency (ECHA), the European Commission reapproved the use of copper sulphate in organic farming for potato, tomato and apple production (Michalopoulos, 2018).

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Health impacts

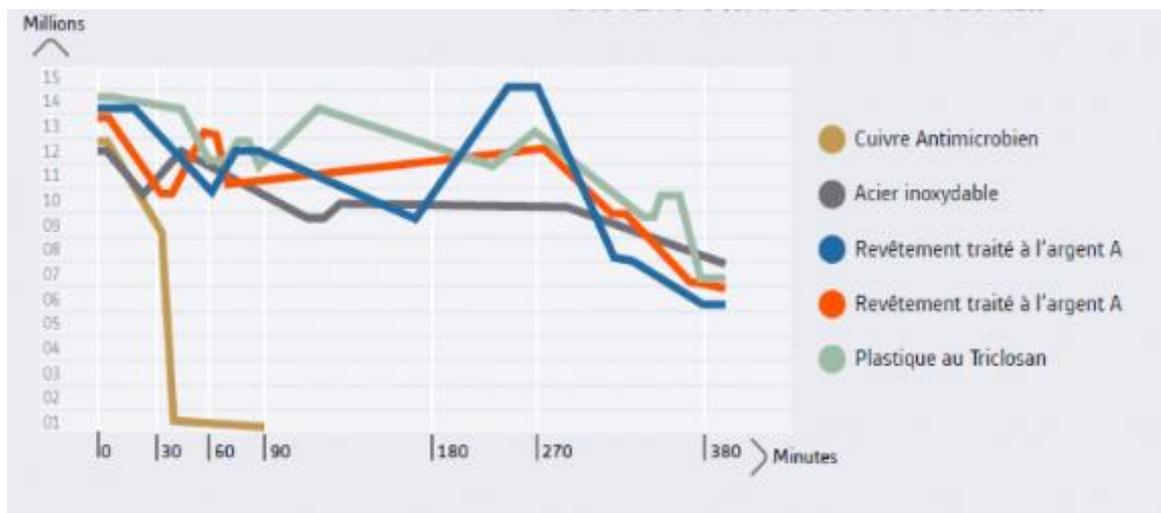


Figure 18. Decline curve for bacteria on copper (in Colony Forming Units).
Source : Antimicrobialcopper 2016

- Exposure to copper surfaces kills more than 99.99% of bacteria after two hours. For this reason copper surfaces are often preferred in healthcare facilities (Centre d'Information du Cuivre, Laitons et Alliages [Information centre for copper, brass and alloys], 2010)
- The daily requirement of copper for an adult to maintain good health is 1mg (Centre d'Information du Cuivre, Laitons et Alliages [Information centre for copper, brass and alloys], 2010).
- Nosocomial (hospital-acquired) infections kill more people than breast cancer, road accidents and AIDS combined (Childs 2006).

Copper is present in numerous food products, in water and in the air. Consumers absorb significant quantities of copper each day. On average, an adult can consume an average of 1mg of copper per day, which can be found in foods such as chocolate, nuts and grains. A daily uptake of copper is not necessarily harmful if the quantity is reasonable. However, excessive quantities can have serious consequences for the consumer's health

The average consumption in Europe does not seem to create a risk. The European Commission has stated that water contains about 0.7mg of copper per litre, much less than the 2.0mg accepted by the World Health Organisation. Copper concentration in soil is also much lower than the levels internationally considered to pose a risk to health. Overall, copper does not appear to be carcinogenic, mutagenic or reprotoxic. However, in 1999, Barceloux highlighted that chronic copper toxicity was especially harmful for people with glucose-6-phosphate dehydrogenase deficiency and for Wilson's disease sufferers. The few studies on prolonged exposure to copper show above all that these effects depend on the manner of exposure (Chappuis, 1991). A high level exposure can give rise to certain kinds of irritation, headache, stomach-ache and vertigo.

But, above all, copper has intrinsic cleansing properties for the environment. Indeed, copper enables more effective control over viruses, fungal growth and the spread of germs. Its antibacterial property also helps to improve food hygiene. In this context, the European Copper Institute, the professional organisation of copper producers and processors, recommended in 2010 that antimicrobial surfaces be made of copper so as to reduce the possibility of contamination in food processing.

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International regulatory framework

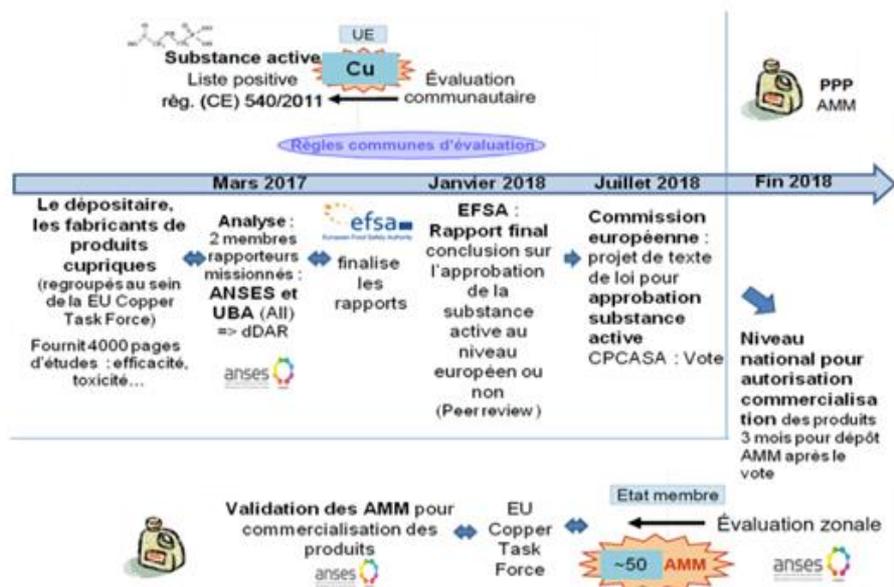


Figure 19. Outline of procedures for the re-assessment of copper.

Source : Fédération Nationale d'Agriculture Biologie [French National Federation of Organic Farming] (FNAB), 2017

- Legislation to reform the French mining code is in discussion with the aim of ensuring it conforms to the Charter for the Environment.
- On 31st January 2019, the EU must decide on whether or not to re-approve copper as a plant protection product.

Regulatory framework for copper extraction

According to the French portal for non-energy minerals (MineralInfo), there is no special restriction on international trade in copper and its alloys. In particular, an overview of the criticality of metals published in January 2018 on the same portal, stressed that copper extraction in the DRC was not affected by restrictions on conflict minerals.

Indeed, copper mines are often regulated by national laws. In the DRC for example, mines come under the Mining Code of 2002, amended and completed by the law no. 18/001 of March 2018, which aims to be “more competitive, with procedures for awarding mining and/or quarry rights that are objective, efficient and transparent, as well as a fiscal, customs, and change regime that encourages investment. Also, since 9th July 2011, the country's legislation includes a law laying down fundamental principles for the protection of the environment with respect to all industrial, agricultural and mining activity. On 8th June 2018, a mining regulation implementing the new Mining Code was published along with annexes containing numerous environmental provisions concerned with operation and production. For example, no production permits will be issued without proof that an impact assessment and an environmental management plan have been carried out.

In Chile, copper mines are governed by the Constitution, by the Mining Law no. 18,097, by the Mining Code (law no. 18,248) and its implementation decree of 1989 making the State the sole owner of mines on the territory of Chile. In addition, the decrees of 2004 and 2007 (no.132/2004 and no. 248/2007) govern safety in mining installations. Lastly, environmental impact studies are at the core of the Chile's regulatory framework for the environment (OECD, 2017).

In France the Mining Code dates from 1956. It was revised in 2011. However, reform legislation is in process, particularly to make it conform more to the 2005 Charter for the Environment. The proposed legislation envisages in particular:

- Taking account of “significant issues for the environment, public health and safety, and the public interest” in the awarding of mining rights,
- Informing the public of, and public participation in, requests for the granting of mining rights (a socio-economic study on their effects, based on a set of specifications).
- The formation of a High Council of mines that would enable a strategic dialogue between “the stakeholders in the exploration and development of underground resources” and answer questions from the Government concerning mining activities.
- The creation of a national register comprising all the administrative decisions that have been implemented through the application of the Mining Code, to be made available to the public electronically.
- The formation of a national policy for mining resources and their use, with the objective of “determining the national direction for the management and valuation of known or estimated resources”.

Regulatory framework governing the use of copper

EU Regulation No 1907/2006 (the REACH regulation) that came into force in 2007, governs the manufacturing and use of chemical products in European industries. However, the regulation does not cover copper metal or copper compounds.

On the other hand, copper metal is an active substance in various plant protection products (PPP). It is used in growing numerous products, such as “vines, in arboriculture, and also growing vegetables such as potatoes and tomatoes” (FNAB, 2018). These products are governed by a general European regulatory framework, and also by very specific conditions laid down in Regulation (EC) No 1107/2009. On 6th July 2016, the European Commission approved the use of copper in organic farming in the fight against bacteria and fungi. Indeed, copper is one of the only mineral products, along with sulphur, that is allowed by EU regulations governing organic farming to combat bacteria and fungi. (Council Regulation (EC) No 834/2007 and Commission Regulation (EC) No 889/2008). As the 2017 activity report of the Fédération Nationale d'Agriculture Biologique [French national federation of organic farming] (FNAB), notes, its use is authorised but is limited to 6kg per hectare per year, “evenly spread over a 5-year period”.

In addition, as noted by the Commission Implementing Regulation (EU) 2018/84 of 19 January 2018, copper nevertheless presents specific risks to the environment, and accordingly regular re-evaluation is necessary, to be carried out every 7 years from 2015. In this context, on 31 January 2019 the EU Commission must decide whether or not to re-approve copper use in plant protection products. For the FNAB, there are 3 possible scenarios depending on the outcome of the decision of the European Commission and the member states at the end of January. Copper may be:

- Not re-approved and not authorised for use,
 - Re-approved but leaving member states free to fix new conditions on its use,
 - Be re-approved but with a lower threshold for use at the European level. This last option was adopted in Commission Implementing Regulation (EU) 2018/1039 of 23 July 2018, which lowered the levels of copper allowed in feedstuffs for weaned piglets, to ensure the health and well-being of these animals. This regulation comes into force on 13 August 2019.
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Alternatives

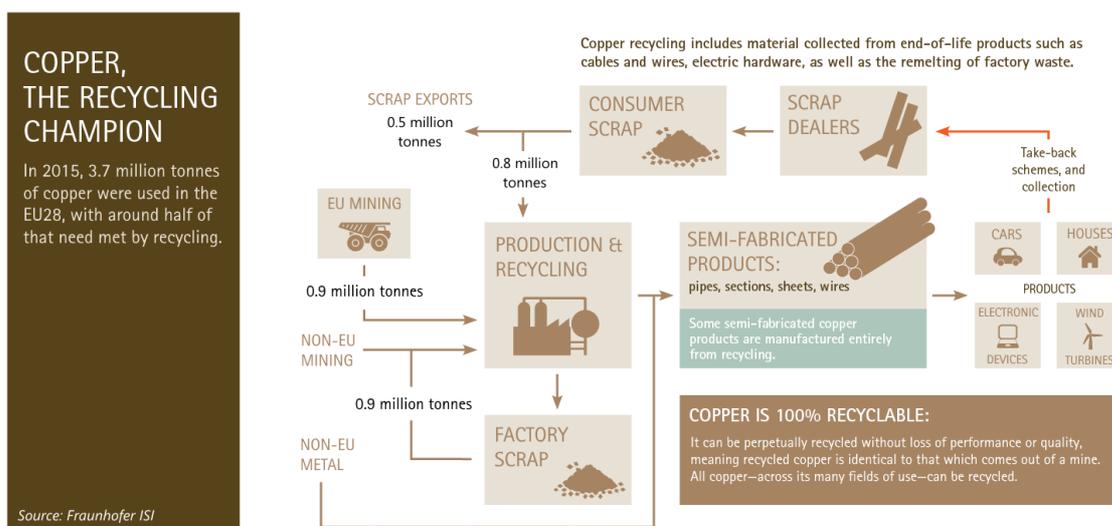


Figure 20. Copper, the leader in recycling in Europe. Source : European Copper Institute, 2015



Figure 21. How far a tonne of copper goes...
Source : European Copper Institute, 2015

- Of the copper used in Europe, 41.5% comes from recycling (ISCG).
- In 2011, 2.1 million tonnes of copper, deriving from end-of-life products and directly-recycled factory scrap (remelting on site), were re-used. This figure represents an increase in 12% in a year (ISCG).
- Recycling requires 85% less energy than primary production. It saves 100 million MWh of electrical energy and 40 million tonnes of CO₂ annually (ISCG).

According to the European Copper Institute, copper can be perpetually recycled without any loss of properties, or quality or performance. For example, in 2008, recycling supplied almost 35% of the global demand for copper. Between 1960 and 2011, recycling increased from 5 to 20 million tonnes of copper.

Recycling enables the reduction of the amount of copper released into the environment and the energy used in its production. Recycled copper is financially quite profitable and 50% derives from the construction sector and household waste (electrical wires and cables, plumbing, and vehicles at the end-of-life). However, recycling copper still presents some difficulties that mean recycled copper cannot supply all current requirements:

- The level of recovery of copper from scrap is limited by its very variable composition, size and shape. (Techniques de l'ingénieur [The Engineer's Methods], 2002)
- The dangers linked to stripping wires, crushing and sorting the waste materials (lack of protection, exposure to non-specific dust and to metal particles from dross and scum, inhalation of fumes such as nitrogen oxides, sulphur dioxide and carbon monoxide).

The European Copper Institute highlights that the yearly amount of waste materials from copper enables a production of recycled copper that does not exceed that of primary copper produced between 20 and 50 years ago. This is due to copper products generally having a relatively long lifetime. The Institute stresses the significance of recycling it, all the more so since European industry is fully equipped with the means and capacity to do so. However, it is not possible to supply current demand entirely from recycling. As a consequence, it is necessary to supply primary materials.

In the agricultural sector, at the ITAB (French Research Institute for Organic Farming) and INRA (French National Institute for Agricultural Research) meeting of 16 January 2018, the question was asked "Is it possible to forgo the use of copper in organic farming?" The answer, unfortunately, was that producers do not at present have a means of replacing copper.

Finally, aside from recycling, with regard to artisanal mines, some NGOs have led initiatives and organised local campaigns to encourage the education of children in mining communities, and also to increase awareness of the health effects of artisanal mining. (Engineers Without Borders, 2016)

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