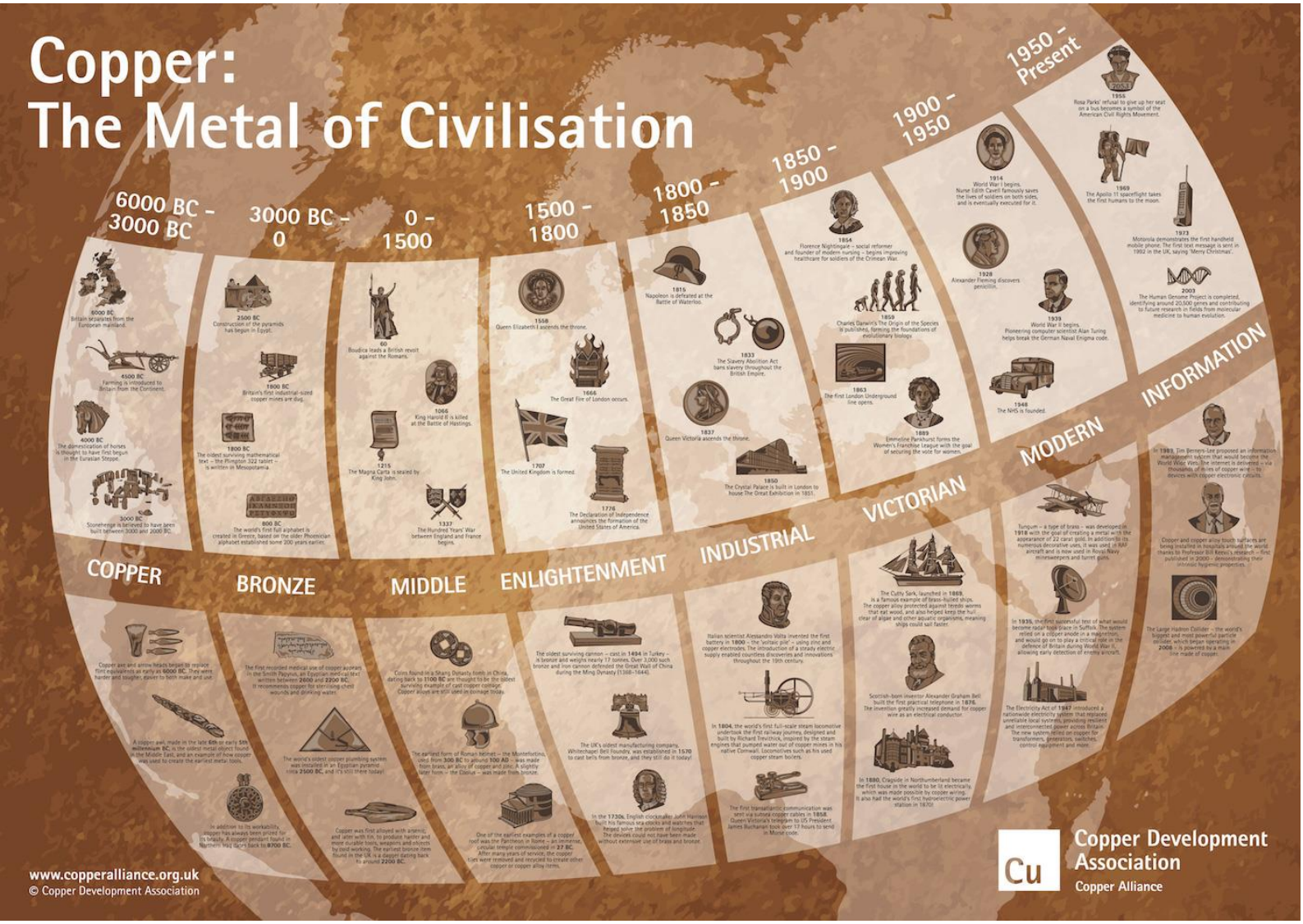
RISKINSIGHT

Materials, Resources and Sustainability series

Reading time: ~20 minutes

Copper – the metal of civilisation



Source: Copper Development Association

Introduction

This paper is part of a series on **materials and resources**. In this series we ask how we can use risk management approaches, techniques and tools to improve the way we source, develop, use and dispose of the materials, resources and products that power our modern economy, and to support everyone involved in their value chains. The series uses the United Nations Sustainable Development Goals (the SDGs) as a common thread to discuss diverse sustainability and risk aspects and elements to each subject.

Copper – nature's conductor…

Copper is indelibly woven into our modern way of life – indeed, it has been for thousands of years. Having the atomic number 29 in the periodic table and the symbol Cu (from the Latin word *cuprum*), copper is forged through nuclear fusion in the largest stars in the universe, and it is fairly widespread in the Earth's crust in various forms. A freshly exposed surface of pure copper is pinkish-orange in colour.

Copper is soft, malleable, and ductile. It is one of a small group of metals that can (but not solely) occur in nature as a "native metal" – that is, in directly usable metallic form. It is believed to have been first used as a substitute for stone in circa 8000 BC.

Copper has excellent thermal and electrical conductivity – second only to sliver in the metals group, whilst being much cheaper – hence its wide application as a conductor of heat and electricity. Its range of uses stretch from building materials and plumbing to industrial machinery, electrical components and surgical tools, and components used in transportation and energy. Copper is used in hundreds of metal alloys, including bronze (with tin) and brass (with zinc). In figurative terms, one tonne of copper is in about 60,000 mobile phones, 400 computers, 40 cars and electricity distribution to 30 homes. [1] Copper compounds are used as bacteriostatic agents, which has generated particular interest during 2020, as people have investigated ways to combat COVID-19, and it is used in fungicides and wood preservatives.

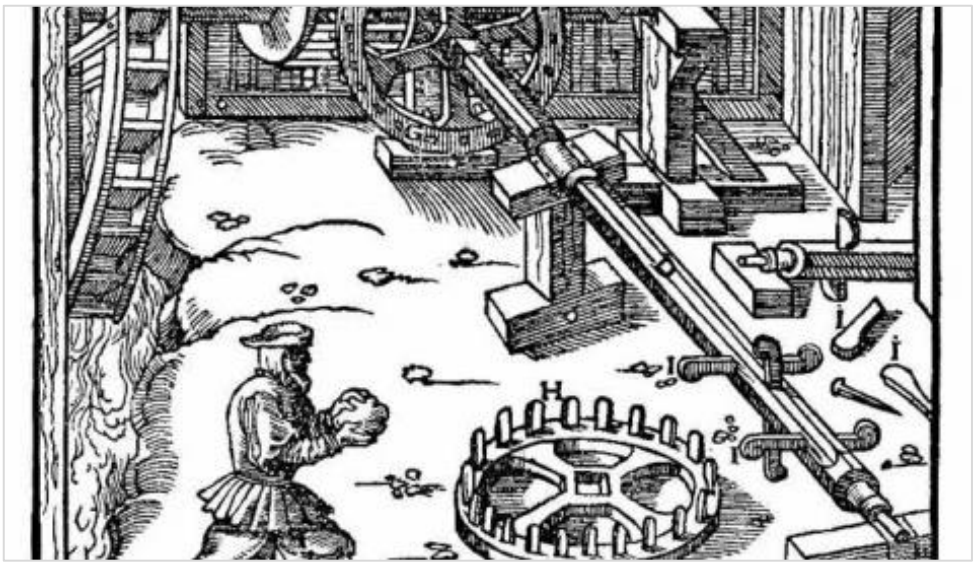
Copper is also essential to living organisms. It is a trace dietary mineral – a key constituent of a respiratory enzyme complex called *cytochrome c oxidase*. The adult body contains between 1.4 and 2.1 mg of copper per kilogram of body weight, found mainly in the liver, muscle, and bone. [2]

Copper in the early ages of civilisation

Copper is intrinsically linked with one of the major 'ages' of human history: the bronze age. [3] It is believed to be the first metal to be smelted from sulfide ores, around 5000 BC. It was first cast into a mould around 4000 BC, and the first metal to be alloyed with another, tin, to create bronze, around 3500 BC (thus marking the dawn of the bronze age).

The name copper has Roman origins. The Romans mined it on the island of Cyprus in the Mediterranean Sea, and called it ***aes cyprium*** (metal of Cyprus). This was later changed to cuprum (Latin), from which coper (Old English) and copper are derived, the later spelling used from the 16th century onwards.

Along with iron (another important metal for all civilisations from Roman times onwards), copper and its alloys have been key to finding metals solutions for society that provide a combination of strength and durability. Its ability to resist corrosion has meant that copper, plus the alloys bronze and brass have for centuries been vital materials through the Middle Ages, the Industrial Revolution and in our present Information Age. [3]



Medieval copper smelter in Norway
Source: ScienceNorway.co

Copper demand soars in the industrial revolution, and onwards

The Industrial Revolution led to a significant ramp-up of the production of copper and its alloys. Greater demand for the raw material led to improvements in output from smelting facilities around the world, as people worked out how to remove impurities from ore containing copper in more efficient ways.

By 1794 the Mines Royal at Neath Abbey, Swansea, were smelting 230 tons of copper ore per week which resulted in 18 tons of copper. The site housed thirty eight furnaces which consumed 315 tons of coal in the smelting operation. Charcoal had been generally used for smelting up to the late 1600s, and the presence of good quality coal was one of the reasons why the Swansea area became the centre of this industry. In 1632 Edward Jorden discovered a method of smelting with pit coal, peat and turf as a fuel, and four years later Sir Philip Vernatt was granted a patent for the use solely of coal for that purpose.

During the 18th Century, the mining of copper in Cornwall in the South West of the UK increased, with a high output being sustained due to the introduction of steam pumps to remove water from the mined pits. This was the first use of steam power in mining, a technique credited to Thomas Newcomen, a Dartmouth blacksmith. The Swansea district, with its coal and commanding position, became an important centre in the world for copper smelting and refining, a position it retained until the latter part of the 19th Century. [20] However, a heavy price was paid for this industrial success. The local air quality in what was previously pristine countryside became so polluted and thick with sulphurous fumes it was said that if the Devil were to pass that way, he would think he was going home. [4]

Welsh copper industry in the 18th century, Swansea
Source: Pinterest

The comparative cost of copper in those days was significantly higher than it would prove to be in the 19th century and onwards to the present day.

The Norddeutsche Affinerie in Hamburg was the first modern electroplating plant, starting its production in 1876. German scientist Gottfried Osann invented powder metallurgy in 1830 while determining the metal's atomic mass. [4]

The Age of Electricity led to a significant rise in demand for copper from the 1880s onwards. From that point until the Great Depression of the 1930s, the United States produced one third to half the world's newly mined copper as it powered ahead with its use of electricity. Major districts included the Keweenaw district of northern Michigan, primarily native copper deposits, the vast sulphide deposits of Butte, Montana in the late 1880s, and the porphyry copper deposits of the Souhwest United States, especially at Bingham Canyon, Utah and Morenci, Arizona. The introduction of open pit steam shovel mining and innovations in smelting, refining, flotation concentration and other processing steps led to mass production.

Flash smelting of copper was developed by Outokumpu in Finland and first applied at Harjavalta in 1949. This energy-efficient process still accounts for some 50% of the world's primary copper production.

The Intergovernmental Council of Copper Exporting Countries was formed in 1967 by Chile, Peru, Zaire and Zambia to oversee the copper market in a similar way to how OPEC oversees the oil market. It never achieved the same influence, mainly because the second-largest copper producer, the United States, never signed up. The group dissolved in 1988.

Copper today

Today, copper is mined in more than 20 countries across the globe. The world's largest producers by geography are Chile, Peru, China and the US, according to the International Copper Study Group (ICSG). Extracting copper is not reliant on one particular country or region, noting that North and South America account for the majority. [5] Chile, currently the world's largest copper producing country, is home to five of the twelve largest copper mines in the world, with the rest of the "top twelve" located in Peru, Mexico, Indonesia, the US and Russia. [21]

Copper production in 2019 [6]

- Preliminary figures show that global copper mine production in 2019 reached 20.5 million tonnes. The largest country producer of mined copper was Chile (5.8 million tonnes, 28%).
- Smelter production in 2019 was approx. 20 million tonnes. China was the largest producer by far.
- Refinery production in 2019 increased to 24 million tonnes, including 4.1 million tonnes of secondary refined production. Again, China was the largest producer.

Copper use [6]

- Refined copper usage in 2019 reached 24.4 million tonnes. China was the largest consumer of refined copper in 2019, with apparent usage of around 12.7 million tonnes (52%).
- According to the International Copper Association (ICA), equipment was the largest copper end-use sector in 2019, with building construction and infrastructure second.
- New copper applications being developed include antimicrobial copper touch surfaces, lead-free brass plumbing, high tech copper wire, heat exchangers, and new consumer products.

The demand for copper is rising

The demand for, and use of copper (along with other metals) continues to rise. As the world moves toward a low carbon energy future, many reports and publications released over the last few years predict strong continued growth in demand for copper for decades to come. For example, some predict that global consumption of refined copper will rise by approx. 36% to 33.3m tonnes by 2030. [9]

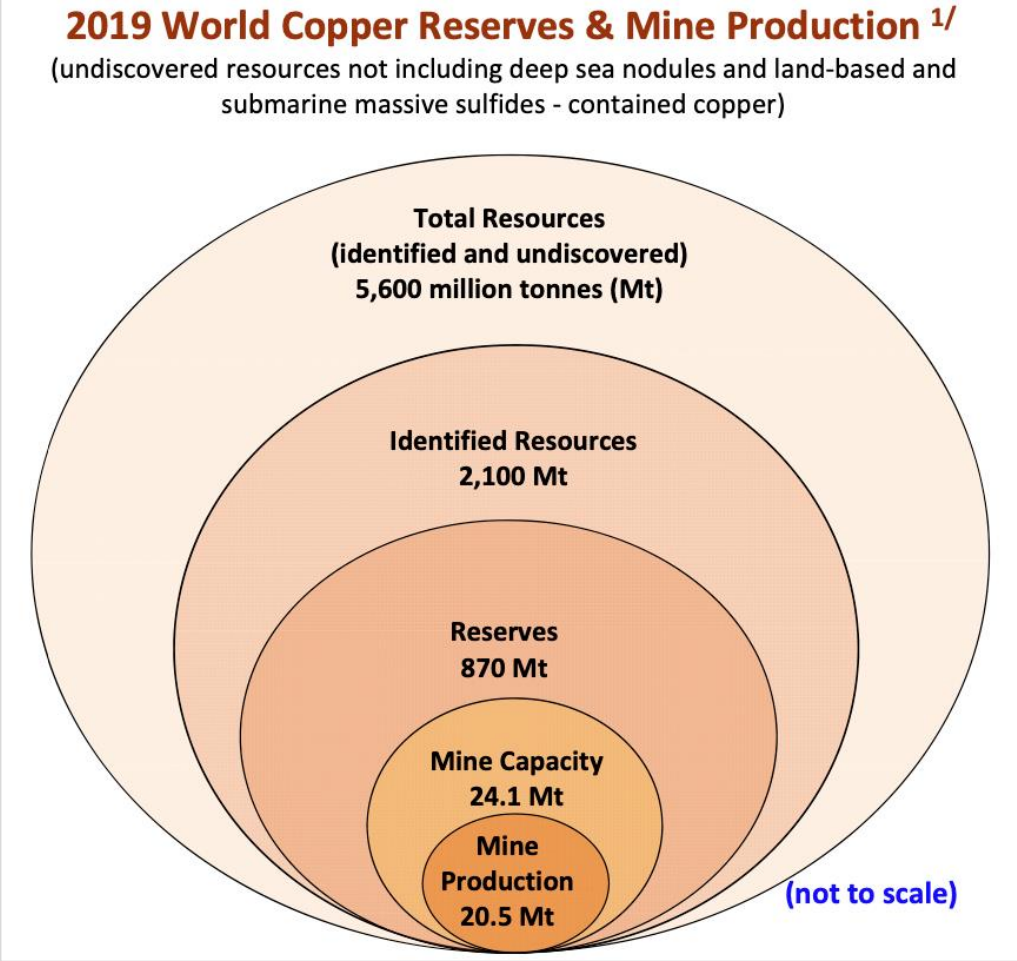
Several long-term trends are driving the appetite for copper. They include the increased use (by consumers and industry) of electronics, an anticipated wider uptake of electric vehicles (EVs), and the increased use of renewable energy sources and energy efficiency. All require copper in their production. Solar panels and wind farms, for example, use up to five times more copper than is needed for fossil fuel power generation, according to industry estimates. Electric vehicles EVs) need about four times more copper wiring than vehicles with combustion engines. [9]

The price of copper

In 2020, the price of copper went on a rollercoaster. It fell through to March (due to COVID-19 fears), then rose by 75% to December 2020, to US$8,000 / tonne. [9]
Many investors believe the growing demand for copper to "wire the green economy" will continue to fuel a further price rise, possibly breaking the early 2011 high of US$10,000 / tonne. It has been reported that analysts think a bottleneck in supply of copper could happen unless new mines are discovered and developed quickly – noting that developing a new copper mine typically takes years.

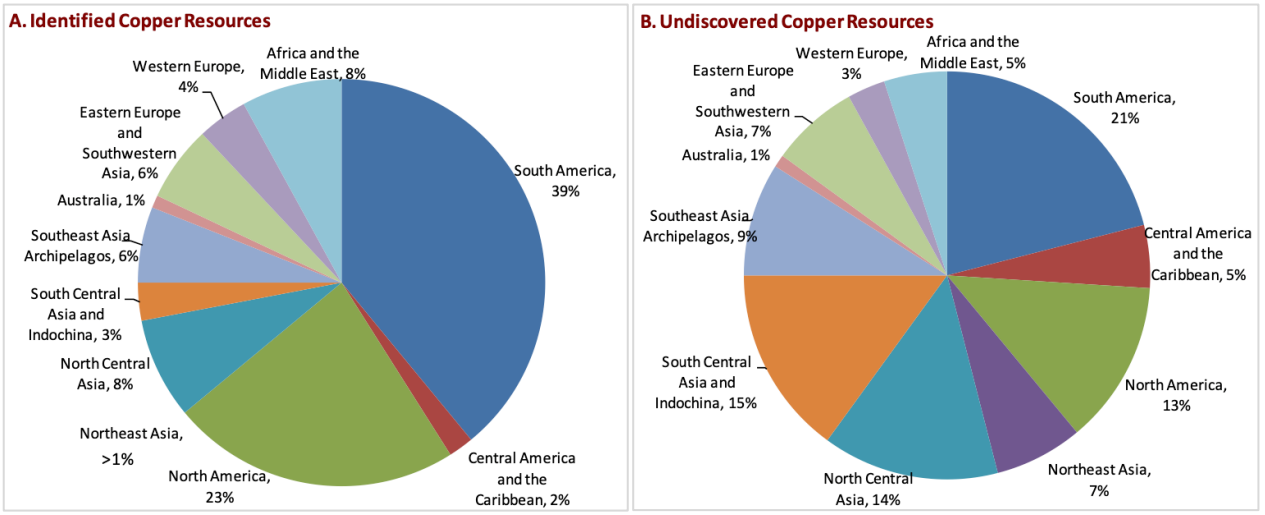
The Earth's resources of copper

It is thought that there is enough copper to meet our growing needs – even as demand continues to rise. Current global copper reserves are estimated at 870 million tonnes, way more than annual copper demand. The International Copper Study Group (ICSG) estimates that total copper resources are 5,600 million tonnes (estimates have continued to rise as more exploration has taken place). [6]
In addition to identified reserves, it is worth noting that, as of today, 35% of demand is met with recycled copper, which reduces the need for mined copper.

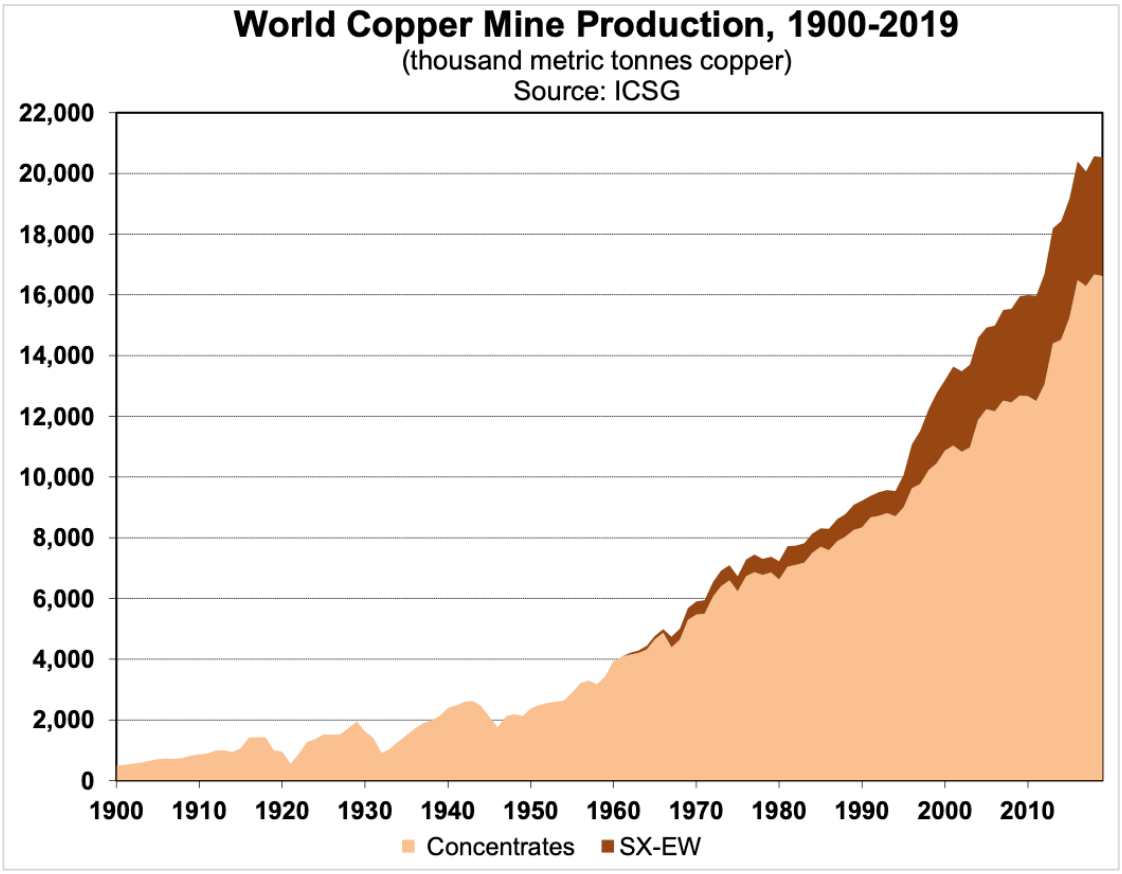


Source: International Copper Study Group – World Copper Factbook 2020

(Reserves are discovered deposits that have been evaluated and assessed to be economically profitable to mine. Resources are bigger and include reserves, discovered deposits that might be profitable, and undiscovered deposits that are predicted based on preliminary geological surveys)



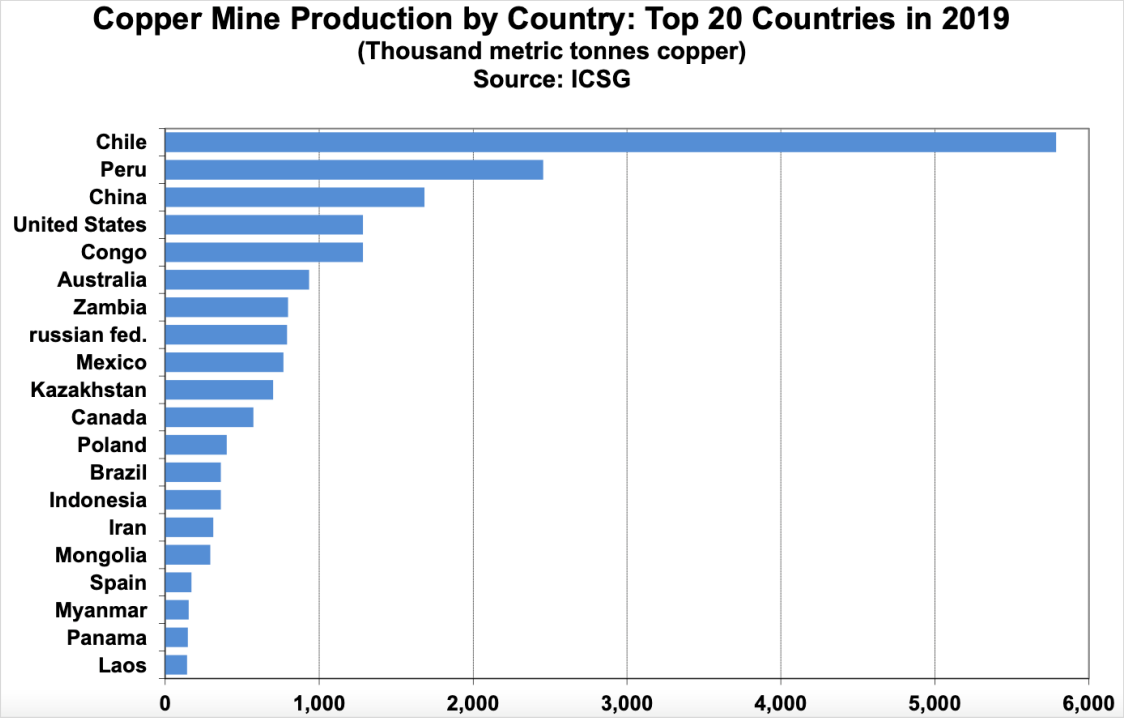
Source: International Copper Study Group – World Copper Factbook 2020



Source: International Copper Study Group – World Copper Factbook 2020

(concentrates are sulphide ores processed for smelting. SX-EW is from mines using dump or heap leaching, solvent extraction and electrowinning to produce cathode copper)

South America – Chile and Peru in particular – has experienced large increases in copper mine production in recent years.



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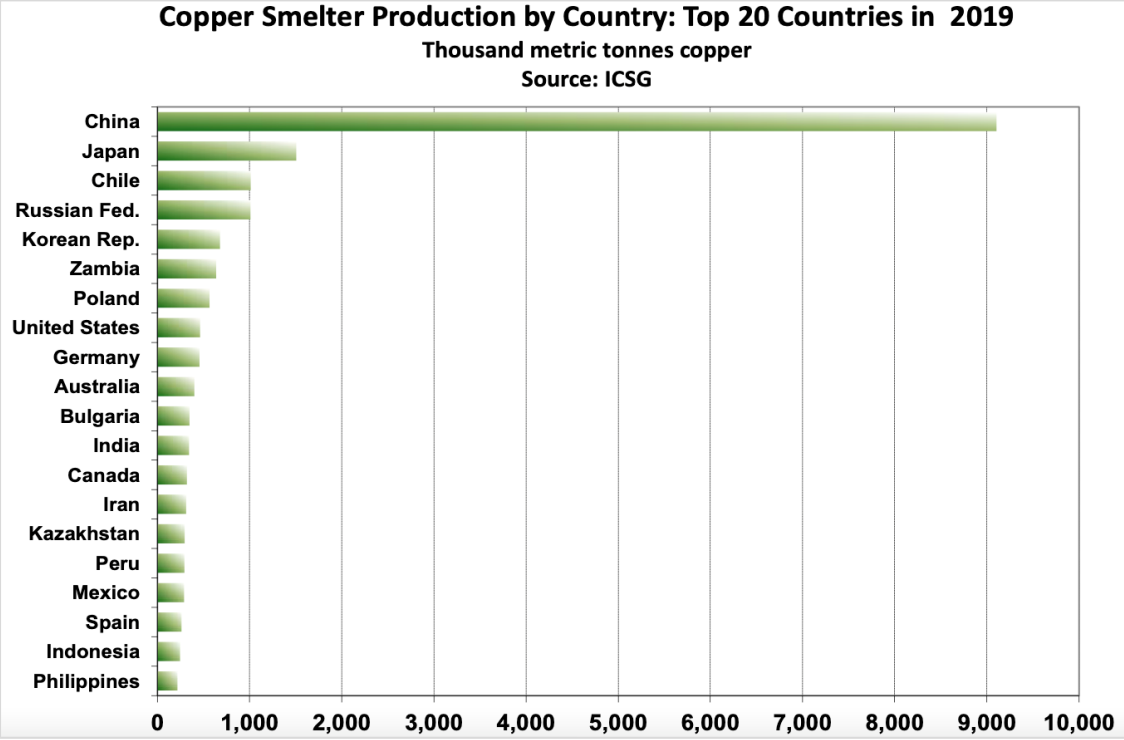


Source: International Copper Study Group – World Copper Factbook 2020

Trade flows of copper exports and imports are summarised as follows:

Major **Exporters** of Copper Ores and Concentrates, 2019

1. Chile
2. Peru
3. Australia
4. Mexico
5. Canada
6. Mongolia
7. United States
8. Brazil
9. Spain
10. Kazakhstan

Major **Importers** of Copper Ores and Concentrates, 2019

1. China
2. Japan
3. Korean Rep.
4. Spain
5. Germany
6. India
7. Bulgaria
8. Russian Fed.
9. Mexico
10. Finland

Source: Copper Development Association

How copper is mined

The types of copper deposits vary. [13] Copper mining will continue to evolve through the discovery of new deposits, technological improvements, efficient design. Some reserves of copper are more challenging, and costly, to extract than others. The technological challenges posed can make projects challenging to undertake. For example, the Oyu Tolgoi mine in Mongolia is being constructed with new innovation to mine the copper (and also gold) reserves. [10]

Those in the copper industry believe there is enough copper to meet current, and future, demand. As part of meeting demand, it is vital to maximise the renewable nature of copper through its recycling and reuse. [6]

To ensure the supply of copper will be there for renewables and EVs, things will need to be done in a smart and efficient way. Investment by industry players will be required, together with having political certainty and stability in the geographies where copper is mined and exported (noting the diverse range of supply geographies). Stability of copper production around the world needs to be matched with stable permitting conditions for copper to be extracted and processed efficiently and sustainably. Mine permitting processes for existing mines to expand to meet growing copper demand are often slow. There may be opportunities for streamlining of such processes. Political certainty and a stable permitting framework also ensure good environmental standards and positive local community engagement can be achieved in the best way.

Looking at copper with the SDGs

The production and use of copper can be examined through the lenses of the SDGs. Looking at resource consumption and responsible use and disposal through the SDGs helps to give a balanced view of our use of coal, and how to ensure a measured approach to energy policy is taken moving forward.

1. No Poverty

Many parts of the world where copper is mined are low-income geographies. In these areas, mines and copper processing plants are important contributors to their economies. How people are employed and how communities are positioned to thrive for the long term is an important part of tackling poverty in such areas.

It is claimed that some copper producing countries that are in the lower national income bracket do not do enough to reinvest revenues from copper taxes to tackle the poverty they have. Take for example, Zambia, which relies on copper mining for a large amount of its exports and is the world's eighth largest copper producer. [32] In such places, employment can go up or down depending on the price (and demand) of the commodity (which, in 2020, has boomed as noted earlier). Zambia has come under scrutiny by some observers for failing to use revenues from copper prices to effectively fight poverty. [12]

3. Good Health & Wellbeing

Copper's beneficial properties for health

Copper's antimicrobial properties mean that the metal and its alloys can be used to eliminate pathogens and reduce the spread of infectious diseases. [8] For example, copper has been used in various ways in hospitals for many years (though it is not universally adopted as a standard).

The first recorded use of copper as an infection-killing agent comes from Smith's Papyrus, the oldest-known medical document in history. The information it contains has been attributed to an Egyptian doctor circa 1700 BC and it is believed it builds on information that dates back as far as 3200 BC. The Egyptians designated the ankh symbol, representing eternal life, to denote copper in hieroglyphs. [8]

Heavy metals including gold and silver are antibacterial, but copper is one of the best around due to its atomic makeup. Copper has a free electron in its outer orbital shell of electrons which takes part in oxidation-reduction reactions (and also contributes to the metal being such a good conductor). This process helps it to be what some have referred to as a "molecular oxygen grenade."

Research has found that copper kills microbes in various ways. When a microbe lands on copper, it is continually fired at by ions, which prevent cell respiration and punch holes in the cell membrane or viral coating, creating free radicals that accelerate its elimination, especially on dry surfaces. Furthermore, the ions in copper seek and destroy the DNA and RNA inside a bacteria or virus, which can prevent mutations of the type that lead to drug-resistant superbugs. These antimicrobial properties of copper do not degrade. [8]
Research is being undertaken to assess copper's effects on SARS-CoV-2, the virus that causes COVID-19. [33]

How copper is mined

As well as the known health properties of copper, it is important to consider the health and wellbeing of those that work in the copper industry. This matter is linked to how governments and employers around the world ensure that people are treated well and that their health and wellbeing is looked after.

6. Clean Water and Sanitation

How copper is mined

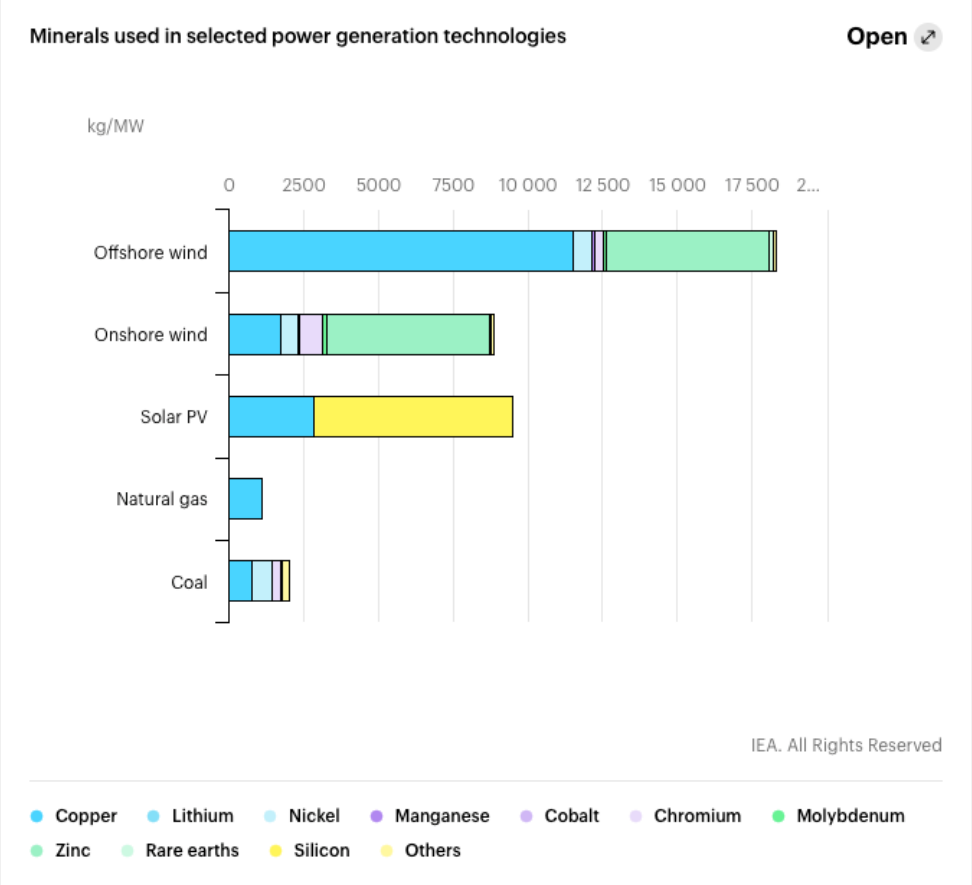
Water scarcity is one of the key challenges for SDG #6. It is stated as a priority for the Copper Alliance® and its members. Most mining is water intensive, particularly during the separation and transportation of ore and tailings. The mining of copper needs to ensure that communities around the mine operations, including those downstream, maintain clean water. This is especially important in arid mining areas of the world. [34, 35]

Copper's benefits towards clean water and sanitation

Copper is of course an important material for plumbing services. As stated earlier, it has natural antimicrobial properties that make it an ideal material for this purpose. Copper does not rust, meaning that it can last in such installations for a long time.

7. Affordable and Clean Energy

As an excellent thermal and electrical conductor, copper can improve the efficiency of energy production and distribution systems. [6] Crucially for the future, it is an important material for renewable energy technologies, and is central to producing clean energy solutions around the world.



Source: the IEA, Clean Energy report

However, some copper mines still use coal for their energy needs, to power the mines and processing. Work must be done to change this energy source to a more sustainable alternative.

8. Decent Work & Economic Growth

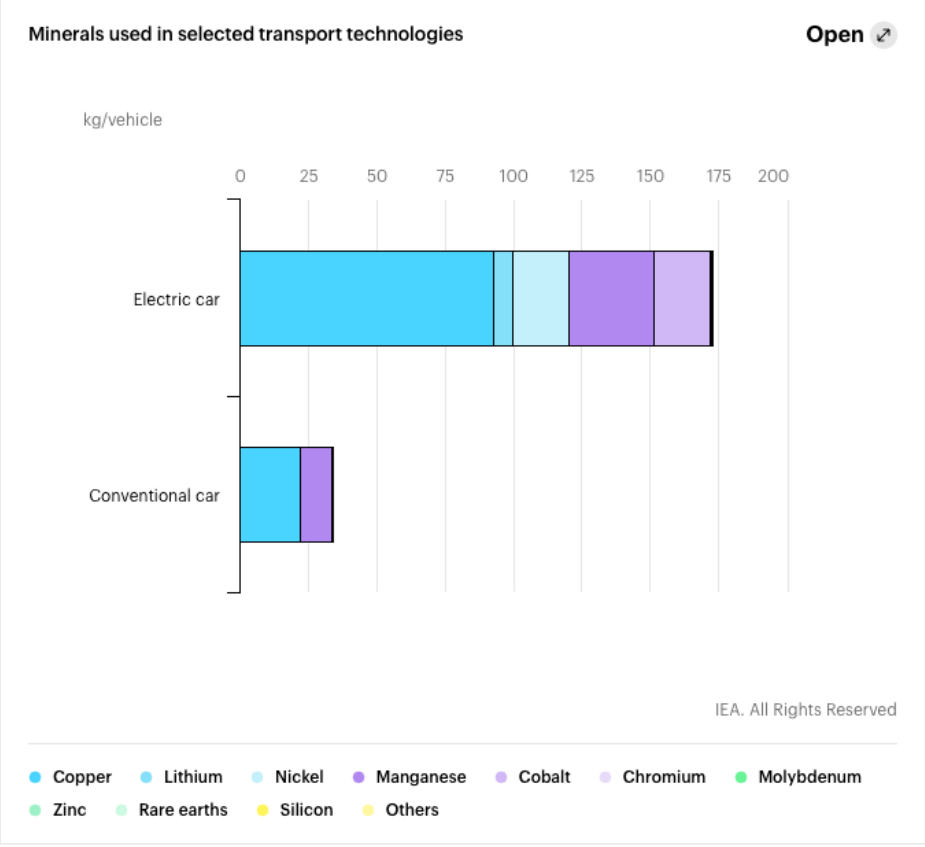
The copper industry and all the industries it supports account for a great deal of employment and economic activity around the world. The range of industries includes the mining of the ore, processing plus many industries that use the final product, such as plumbers, electricians, transportation business workers.

For some parts of the world, such as countries in South America and Africa, the mining of copper represents a large part of government income and tax revenues.

Since it is linked to investment in renewable energy and EVs, the forecast increase in copper demand will help to spur economic growth.

9. Industry Innovation & Infrastructure

Copper is of course intrinsically linked to innovation towards renewable energy and more sustainable forms of transport, such as EVs.



Source: the IEA, Clean Energy report

The mining industry is undertaking various initiatives around the world to improve the sustainability of copper mining, from ore extraction through to tailings. The process of smelting copper is currently being reviewed for ways to make it more energy efficient and more sustainable.

11. Sustainable Cities and Communities

It is clear through its linkage to renewable energy and sustainable forms of transport that copper is a key resource for making cities and communities sustainable.

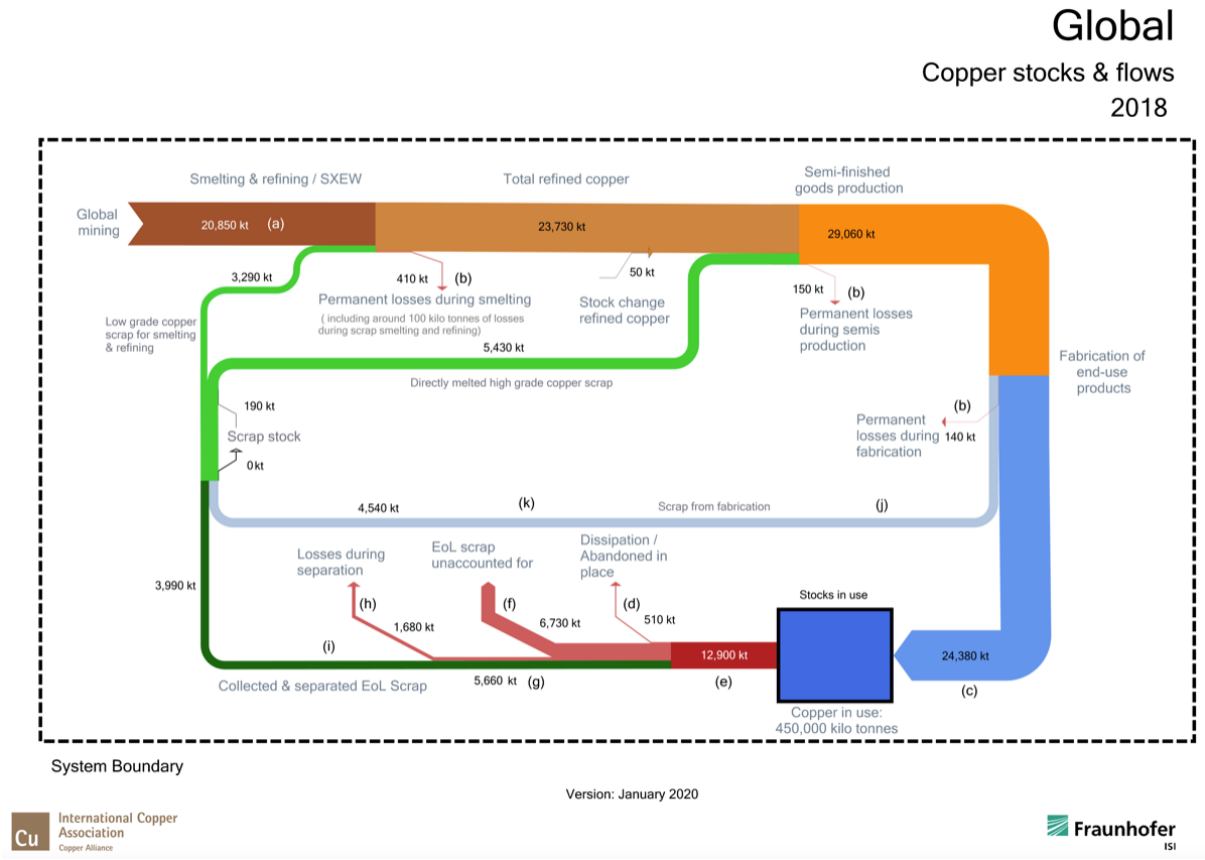
Equally, its antimicrobial properties may continue to play a valuable role in future, in addition to the role it already plays in the built environment (for plumbing, roofing and other uses such as various components of a building's interior).

There is close linkage to SDGs #1, #8 and #12 through efforts to help make the communities where copper is found sustainable.

12. Responsible Consumption & Production

As has been described in this paper, copper is used in many modern devices, instruments, technology and the built environment. Whilst the recycling of copper is quite high, there may be more that can be done to reuse and repurpose copper components once they reach their end of life in their existing form.

The diagram below summarises copper stocks and flows, and reuse, as of 2018.



Source: International Copper Study Group – World Copper Factbook 2020

Copper and recycling

Copper is one of the most recycled of all metals, and has been for some time. Indeed, the ease of which it can be recycled many times has long been one of its defining features.

Based on the global copper stocks and flows model developed by the Fraunhofer Institute, it is estimated that two thirds out of the 550 million tonnes of copper produced since 1900 are still in active use (Glöser, 2013). [14] During the last decade, over 30% of annual copper use has come from recycled sources. Will this trend continue, as forecast demand for the metal keeps rising?

Recycled copper (also known as secondary copper) cannot be distinguished from primary copper (copper originating from ores), once it is reprocessed. Recycling copper extends its efficiency of use, it provides energy savings and ensures that carbon emissions through the extraction and processing of copper are lower than would otherwise be the case.

The concept of *Urban Mining* – which extends from recycling – is now being discussed. It may become an important part of the circular economy, to organise the collection of discarded products and to return a greater quantity of secondary raw materials efficiently back into use. By treating waste as a resource, Urban Mining may play a valuable role, alongside conventional mining and existing recycling, to meet the increasing demand for copper and other raw materials. [19]

13. Climate Action

Copper mining and processing inevitably produces carbon emissions. Whilst, according to Our World in Data, they are relatively small on a global scale, it is important to reduce emissions. [18] The extent of emissions depends on a number of factors related to the specifics of how copper is mined and produced, including the ore head grade, the mining method and geometry, the mineralogical properties of the copper ore such as level of oxidation, mineral textures, grain size and the like, the hardness of the ore (hence the energy required to break it down), and the specific geographical factors such as proximity to power and water sources. [16]

The majority of copper mines are large, low grade, open pits. A large proportion of global copper mine production is from sulphide ores that are processed using grinding and flotation plants to produce concentrates for smelting. The remainder comes from mines using dump or heap leaching, solvent extraction and electrowinning to produce cathode copper (SX-EW). [17]

The processing of copper leads to environmental degradation. For example, copper ores contain elements like sulphur, which could be damaging. As more copper is produced, there will be environmental impacts. However, at least two trends can counteract these developments: first, technical progress in copper extraction and processing, and second, increasing the use of recycled copper.

Reducing carbon emissions is a challenge to be solved by the copper industry, and investments are being made to make headway. Whilst the global economy needs more copper as well as other metals such as nickel, cobalt, lithium and others, mining companies need to work out how to meet this demand whilst reducing their environmental and social impacts. Environment, Social and Governance (ESG) assessments are increasingly being used in the risk assessments of investors.

16. Peace, Justice & Strong Institutions

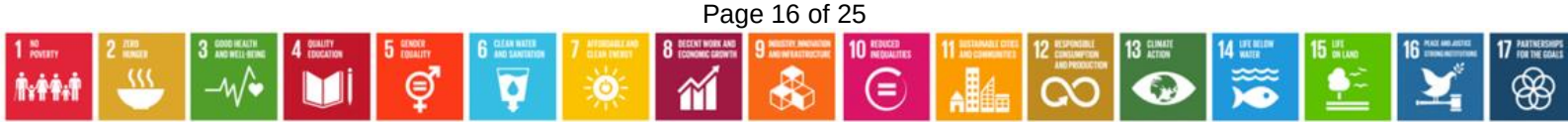
The stability of copper production requires political certainty and stable permitting conditions for it to be extracted and processed efficiently and sustainably. As mentioned earlier, mine permitting processes are often slow to arise for new mines, and for existing mines to expand. There may be opportunities for more streamlining of such processes.

Political certainty and a stable permitting framework also ensure environmental standards and community involvement can be done in the best way.

Strong institutions help ensure that taxes on the mining and exporting of copper are reused and invested in the best way possible.

17. Partnerships for the SDGs

The focus on SDG #17 is about ensuring that businesses, the industry, governments and other organisations can work together to solve future needs. This is intrinsically linked to all the SDGs.



What is the position of different groups on copper?

The general public

The general public is becoming more and more aware that copper has many uses, including in important sustainability efforts for the future.

During 2020, as part of the wealth of reporting about the COVID-19 pandemic, many people will have found out about copper's antibacterial properties, thus seeing it in a positive light for health and sanitation.

Governments and international public policy

Due to the geographic areas where copper is extracted and processed, the metal plays an important role in government policy. This includes how workforces and unions have a say in how mine sites and production facilities are run.

Particularly in developing parts of the world, current new projects that are well underway in places such as Chile, Peru and Mongolia are often reported on in the media. Major new copper sourcing projects are expensive and challenging to undertake, and the structure of how they are set up means that governments have a stake in how they are set up and run.
For example, the Oyu Tolgoi mine is a crucial part of Mongolia's economy. As well as being the country's biggest source of foreign direct investment, it also provides thousands of well-paid jobs and according to some estimates, the underground mine could contribute 30% of the country's GDP when it reaches peak production. [22]
Similarly, the Quellaveco copper mine in Peru has the potential to be a "generational" asset with enough reserves to supply decades, if not a century of production. [23]
Africa's largest exporter of copper, the Democratic Republic of Congo (DRC), is highly dependent on the metal for its revenues. Together with cobalt mining, it represents some 20% of the country's GDP and is therefore key to the government's economic strategy. [24]

NGOs, Environmental campaigners and Not for Profit Foundations

NGOs involved in the copper industry include the Alliance to Save Energy, CLASP, International Institute for Energy Conservation, Clean Energy Solutions Center, Solar Electric Light Fund and the United Nations Foundation. [25]

NGOs have been active for many years, on a general basis, to support ethical mining, including copper mining.

As with other mining, campaigners and activists do get involved in demanding support and financial assistance to mining areas. [31]

Academic Research and Scientists

The many uses of copper mean that it has been the subject of much research, in various ways, for many years. Research also includes how copper mining can lead to improvements in the developing nations where such mines are situated.

With its use towards many aspects of sustainability anticipated for years to come, this will continue.

Financiers and Investors

As with other industries, investors are playing an increasingly vocal role in how copper is mined and used. As long-term projects to mine the element take time and are expensive, investors have a major influence, and are increasingly wanting to see evidence of adherence to strong ESG frameworks.

While there are other factors to consider when valuing a copper deposit (including mining costs, the average grade of a deposit, the type of ore), a world-class copper deposit is one that contains a copper resource whose value far exceeds the cost of mining and refining. [13] Mining company shareholders and investors scrutinise new projects, mindful of the challenges that are involved.

After several major copper mine projects are completed in the next couple of years, the pipeline of new projects afterwards is uncertain. Key to this is whether investors will have an appetite to fund growth, and new projects. To extend the lives of existing mines, or to unlock potential high-risk projects, higher commodity prices may be needed, according to industry experts. Some believe an extended period of copper trading of approx. US$8,800 / tonne will be needed to fund long-term projects. Others think it may require US$10,000 / tonne. Nonetheless, investment banks are positive about the future prospects for copper.

Copper industry associations and producers

The International Copper Association (ICA) has 32 members which represent a majority of the world's primary copper production, some of the largest mid-stream smelter / refiners, and ten of the world's largest copper fabricators. The ICA partners with more than 500 organisations globally through regional and local centres as part of the Copper Alliance®. [26]

Other industry associations exist in various countries where copper is mined, used and traded as a commodity.

Business and industry

Business and industry is the key driver behind how copper is mined, refined and used.

Mining

According to the ICA, the copper mining industry is investing significantly in innovation and sustainable solutions. It reports that, on average, members of the Copper Alliance® invest a combined US$20 billion a year to improve their contribution to sustainable development towards aspects such as protecting the environment and ensuring the safety of their operations. [5]

While it is known that enough copper supply exists in the Earth's crust, high-grade projects in mining-friendly jurisdictions are becoming rarer, meaning that more expensive and riskier projects are required. Some discoveries that are made are in locations that do not have ready-made infrastructure, and some are being developed by companies with less mining experience. [9]

An increased focus on ESG and the impact of mining on the environment and social aspects of where it takes place means it can take a decade to develop a new mine.

Chile's Codelco, the world's largest copper producer, has outlined sustainability plans in five areas of action for its operations and projects, including goals to cut carbon emissions by 70%, reduce inland water consumption by 60% and recycling 65% of its industrial waste by 2030. [15]

Many other miners are implementing advances with clean energy, technology such as AI and focusing on various SDGs as part of their commitment to sustainable copper mining. [27]

Copper and the electric vehicle (EV) industry

Copper is critical to the growing EV revolution. EV manufacturers around the world are using copper because of its high electrical conductivity, durability and malleability. More is used in charging stations and in supporting electrical grid infrastructure. [28]

Copper and recycling

Many businesses exist around the world to recycle copper – it is a major industry in its own right.

Traditional recycling technologies are well established. New ones are being introduced to manage the recycling of complex devices, such as circuit boards and industrial catalysts. [29]

What can Risk and Operations teams in various industries do?

Risk Managers and Risk Advisors in all organisations can play a valuable role in working out how they can achieve their sustainability objectives, and how to take and manage risks to do so. Sustainability is business-critical today – from investors that are demanding to see strategies are in place, to employees who want to work for a business that demonstrates purpose. Risk professionals can be trusted advisors who can help people to achieve objectives, using risk-informed decision-making and risk tools and techniques to work out which risks (opportunities) to take and which risks (threats) need to be managed.

With regard to any organisation's direct or indirect use of copper, Risk Managers and Risk teams can work with their colleagues in Sustainability and Operations to think through how, for their organisation's particular circumstances, they should approach their situation. If an organisation procures products that use copper, how can they ensure that it is procured responsibly? Using good Risk tools and thinking carefully through your options can help you to work out what is most feasible and impactful to you, now and in future.

Consideration	Ideas and thoughts for consideration
1. What exactly do you do, and do you know what your uses of copper are?	• What do you design and / or produce, and how much copper is in them now / will be in future? • For the products that you use and / or procure, do you know how much copper is used to make them? • For the buildings that you occupy (or construct), do you have a position on the use and benefits of copper? • Will the price of copper have an impact on your future use / pricing of your own activities / products? • Whether you produce physical assets or information-based assets, what can you do to ensure your consumption of copper is from responsible sources? • Do you know how much of the copper you use is from responsible recycling? • In your use of copper, are you asking your suppliers about their use of this element, and what they are doing to ensure it is responsibly sourced? • Are you able to set expectations on responsible and sustainable copper use into any contractual agreements with your suppliers? • When it comes to shipping of copper for your needs, either directly or indirectly, are you asking about the CO_2 emissions involved in shipping and ways to reduce them (e.g. refer to an associated paper on the shipping industry).
2. Do you have the opportunity to be	• Are there opportunities for you to be involved in industry-specific or cross-industry / academic

Consideration	Ideas and thoughts for consideration
involved in any research (are you already)?	research into responsible sourcing and use of copper?
3. How does copper influence your use of renewable energy / EVs?	• If you have activities underway for renewable energy and / or EVs, do the partners you are working with provide information about the extent of copper involved in them?
4. Do you know your investor expectations, for sustainability of businesses they invest in?	• Do your investors have expectations about your energy footprint, and the part that responsible use of copper can have on this? • Are any of them talking about the responsible use of copper? • Are you engaging with them in how your green energy solutions could benefit their investment funds?
5. Sustainability reporting	• Have you thought about how activities in responsible copper extraction / use may help you with your sustainability reporting and your sustainability commitments? • For the electronics and computers that you procure and recycle, do you know how much copper is recycled from them when they are disposed, and by whom?

Conclusion

This paper has discussed how the demand and supply of copper is increasing around the world, and the many benefits that it provides.

Copper is one of the most recycled metals. It is estimated that two thirds out of the 550 million tonnes of copper produced since 1900 are still in active use (Glöser, 2013). [14] During the last decade, over 30% of annual copper use has come from recycled sources. Will this trend continue?

When seen through the SDGs, it is clear that copper plays an important role in many of them – including helping to combat poverty (SDG #1) in parts of the world where it is mined through to its important role in health (SDG #2), clean water and sanitation (SDG #6), affordable and clean energy (SDG #7), decent work and economic growth (SDG #8), sustainable cities and communities (SDG #11) and responsible consumption and production (SDG #12).

Copper is a key enabler of many of our green technologies that are forecast to shape the world for years to come. It will continue to play a valuable role as we implement sustainable solutions for the planet.

Further suggested reading

The Copper Alliance (the International Copper Association, Ltd., ICA) brings together the global copper industry to develop and defend markets for copper and to make a positive contribution to society's sustainable development goals.

Sustainable Copper, by the Copper Alliance, provides a good resource about sustainability in the industry.

The International Copper Study Group (ICSG) is an intergovernmental organization of copper producing and using countries that serves to increase copper market transparency and promote international discussions and cooperation on issues related to copper.
It produces a comprehensive World Copper Factbook (2020).

About the author

Gareth Byatt is Principal Consultant of Risk Insight Consulting. He works around the world with clients in various industries and sectors, including businesses that mine copper, and those that use / procure copper in construction and facilities.

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