THE WORLD COPPER FACTBOOK 2024

INTERNATIONAL
COPPER
STUDY GROUP

Table of Contents

About ICSG

The International Copper Study Group (ICSG) was formally established as an autonomous inter-governmental organization on 23 January 1992, following a series of Ad Hoc meetings sponsored by the United Nations (UNCTAD) in 1986 and 1987 to review the world situation of copper and discuss the need for such a body. ICSG serves to increase copper market transparency and promote international discussions and cooperation on copper-related issues.

In order to fulfill its mandate, the Study Group has three main objectives:

- Increase market transparency by promoting an exchange of information on production, consumption, stocks, trade, and prices of copper, by forecasting production and consumption, and by assessing the present and future capacities of copper mines, plants, smelters, and refineries.
- Promote international cooperation on copper-related matters, such as health and the environment, research, technology transfer, regulations, and trade.
- Provide a global forum where industry and governments can meet and discuss common problems/objectives. The ICSG is the only inter-government forum solely dedicated to copper.

The current members of ICSG are:

- Australia
- Belgium
- Brazil
- Chile
- China
- DR Congo
- European Union
- Finland
- France
- Germany
- India
- Iran
- Italy
- Japan
- Kazakhstan
- Luxembourg
- Mexico
- Mongolia
- Peru
- Poland
- Portugal
- Russian Federation
- Serbia
- Spain
- Sweden
- United States

As part of its mandate to provide a global forum where industry and governments can meet and discuss common problems and objectives, ICSG meetings are held twice per year, typically in the Spring and Fall at ICSG Headquarters in Lisbon, Portugal. The meetings of the Study Group are open to government members, their industry advisors, and invited observers.

ICSG Officers and Secretariat

INTERNATIONAL COPPER STUDY GROUP OFFICERS FOR 2024

Chairperson	Mr. Artur Dabkowski (Poland)
Vice Chairperson	Mr. Li Yusheng (China)

STANDING COMMITTEE

Chairperson	Mr. Joaquín Morales Godoy (Chile)
Vice Chairperson	Mr. Hiroki Yokote (Japan)
Finance Committee Chairman	Mr. José Miguel Martins (Portugal)

ENVIRONMENTAL AND ECONOMIC COMMITTEE

Chairperson	Mr. Dieudonné Tambwe (DR Congo)
Vice Chairperson	Mr. Arun Kumar Shukla (India)
Vice Chairperson	Mr. Antoine Babonneau (France)

Contacts:

International Copper Study Group
Rua Almirante Barroso, 38-6º
1000-013 Lisbon, Portugal
Tel: +351-21-351-3870
Fax: +351-21-352-4035
e-mail: mail@icsg.org
website: www.icsg.org

STATISTICAL COMMITTEE

Chairperson	Mr. Daniel Flanagan (U.S.A.)
Vice Chairperson	Ms. Manuela Ramírez (Spain)
Vice Chairperson	Ms. Cao Mingyue (China)

INDUSTRY ADVISORY PANEL

Chairperson	Mr. Ian Scarlett (IWCC)
Vice Chairperson	Mr. Jorge Cantallopts (CESCO)

SECRETARIAT

Secretary-General	Mr. Paul White
Director of Market Research and Statistics	Ms. Ana Rebelo
Director of Economics and Environment	Mr. Fernando Acosta
Manager of Statistical Analysis	Mr. Juan Luis Rodriguez
Secretary	Ms. Ana-Paula Calheiros

Acknowledgments and Copyright:

ICSG would like to thank the International Wrought Copper Council, the International Copper Association, the Copper Development Association, the European Copper Institute, the U.S. Geological Survey, the U.S. National Park Service, the British Museum and Mr. Luis Hernán Herreros Infante for their contributions to the Factbook.

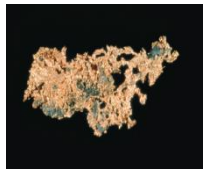
SELECTED ICSG PUBLICATIONS

- **COPPER BULLETIN (monthly)**. The ICSG Copper Bulletin includes annual and monthly statistics on copper and copper products, their production, usage, and trade by country, as well as stocks and exchange prices, providing a global view of supply and demand. Subscribers to the Copper Bulletin receive the Yearbook as part of their annual subscription.
- **ICSG STATISTICAL YEARBOOK**. The ICSG Copper Bulletin yearbook includes annual statistics on copper and copper products, their production, usage, and trade by country, as well as stocks and exchange prices, providing a global view of supply and demand for the past 10 years. The Yearbook serves as a useful tool for consultations and analysis on the longer-term evolution of world copper production, usage, stocks, and prices. Subscribers to the Copper Bulletin receive the Yearbook as part of their annual subscription.
- **DIRECTORY OF COPPER MINES, SMELTERS, AND REFINERIES**. This directory highlights current capacity and provides a five-year outlook of forecasted capacity for over 1,300 existing and planned copper mines, smelters, and refineries on a country-by-country basis, including separate tables for SX-EW plants. Salient data and information for each mine, smelter, and refinery are included and the Directory separates operations between operating, developing, feasibility, and exploration stages. The Directory is published twice per year.
- **ICSG STATISTICAL DATABASE**. The ICSG maintains one of the world's most complete historical and current databases with statistics on copper production capacities, data on copper production, consumption, stocks, prices, recycling, and trade for copper products. In 2012 ICSG launched its **online statistical database** that gives subscribers direct access to ICSG historical data. It also provides subscribers with specific extraction tools for downloading the data.
- **DIRECTORY OF COPPER & COPPER ALLOY FABRICATORS (FIRST USE)**. This directory provides a global overview of companies and plants involved in the first use of copper.
- **THE MINERAL COMPOSITION AND REGULATION OF COPPER CONCENTRATES, SMELTERS, AND REFINERIES (2023)**. Study focused on understanding the changes in the composition of copper ores and concentrates processed in plants, smelters, and refineries, and the regulations affecting this process.
- **THE CHINESE COPPER SMELTER AND REFINING INDUSTRY (2022)**. Study focused on the development of Chinese copper smelter and refining industries, including production outlook, project developments, policies, and regulations.
- **NORTH AMERICAN SEMI MANUFACTURED COPPER PRODUCTS CAPACITY (2021)**. A study focusing on providing a complete picture of fabrication and copper use in North America.
- **EUROPEAN SEMI MANUFACTURED COPPER PRODUCTS CAPACITY (2019)**. A study focusing on providing a complete picture of fabrication and copper use in Europe.
- **SOLID WASTES IN COPPER, LEAD, ZINC, AND NICKEL MINING, SMELTING AND REFINING (2019)**. The study examines mine, smelter, and refinery solid wastes and assesses a range of issues related to these wastes.
- **SMELTING AND HYDROMETALLURGY TREATMENT FOR COPPER SULFIDE ORES AND CONCENTRATES (2019)**. This study focuses on key issues related to plants processing copper sulfide ores and concentrates of different complexity.
- **COPPER USE IN FABRICATION IN JAPAN, KOREA, TAIWAN (CHINA) AND VIETNAM (2018)**. A study focusing on providing a complete picture of fabrication and copper use in Japan, Korea, Taiwan, and Vietnam.
- **INDUSTRIAL USE OF REFINED COPPER AND SCRAP IN FABRICATION IN CHINA (2017)**. A study focusing on providing a complete picture of fabrication and copper use in China.
- **MANUFACTURE AND USE OF SEMI-FABRICATED COPPER IN LATIN AMERICA/CANADA (2017)**. A study focusing on providing a complete picture of fabrication and copper use in Latin America and Canada.

To subscribe to ICSG publications, please see our **Order Form on Page 61**. Alternatively, please visit our website at www.icsg.org

CHAPTER 1: CU BASICS

WHAT IS COPPER?



Copper is a malleable and ductile metallic element that is an excellent conductor of heat and electricity as well as being corrosion resistant and antimicrobial. Copper occurs naturally in the Earth's crust in a variety of forms. It can be found in sulfide deposits (as chalcopyrite, bornite, chalcocite, and covellite), in carbonate deposits (as azurite and malachite), in silicate deposits (as chrysocolla and dioptase) and as pure "native" copper.

Copper also occurs naturally in humans, animals, and plants. Organic life forms have evolved in an environment containing copper. As a nutrient and essential element, copper is vital to maintaining health. Life-sustaining functions depend on copper.

Copper and copper-based alloys are used in a variety of applications that are necessary for a reasonable standard of living. Its continued production and use are essential for society's development. How society exploits and uses its resources, while ensuring that tomorrow's needs are not compromised, is an important factor in ensuring society's sustainable development.

Copper is one of the most recycled of all metals. It is our ability to recycle metals over and over again that makes them a material of choice. Recycled copper (also known as secondary copper) cannot be distinguished from primary copper (copper originating from ores), once reprocessed. Recycling copper extends the efficiency of the use of the metal, results in energy savings, and contributes to ensuring that we have a sustainable source of metal for future generations.

The demand for copper will continue to be met by the discovery of new deposits, technological improvements, efficient design, and by taking advantage of the renewable nature of copper through reuse and recycling. Also, competition between materials, and supply and demand principles, contribute to ensuring that materials are used efficiently and effectively.

Copper is an important contributor to the national economies of mature, newly developed, and developing countries. Mining, processing, recycling, and the transformation of metal into a multitude of products create jobs and generate wealth. These activities contribute to building and maintaining a country's infrastructure and create trade and investment opportunities. Copper will continue to contribute to society's development well into the future.

Images courtesy of the Copper Development Association.

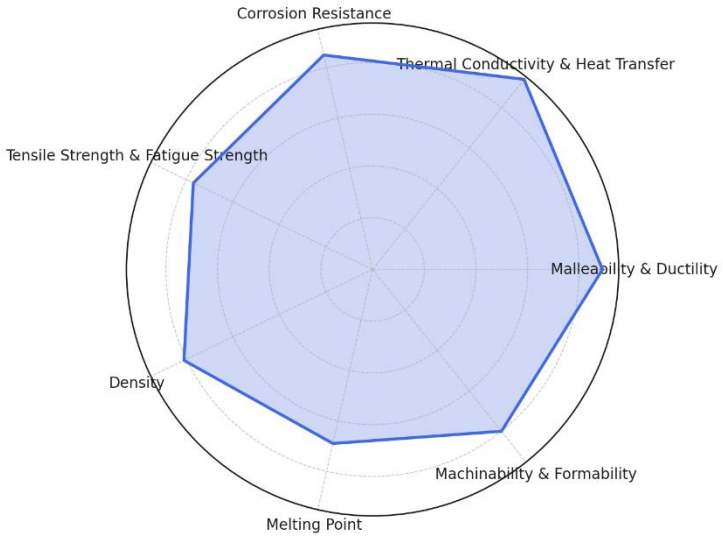
COPPER PROPERTIES AND BENEFITS

Chemical Symbol	**: Cu**
Atomic Number	**: 29**
Atomic Weight	**: 63.54**
Density	**: 8960 kg/m^3**
Melting point	**: 1356 K**
Specific Heat cp (at 293 K)	**: 0.383 J/g.K**
Thermal conductivity	**: 394 W/m.K**
Coefficient of linear expansion	**: 16.5 x 10^{-6} / K**
Young's Modulus of Elasticity	**: 110 GPa**
Electrical Conductivity (% IACS)	**: 1.673 x 10^{-8} ohm-m**
Crystal Structure	**: Face-Centered Cubic**

Copper makes vital contributions to sustaining and improving society. Copper's chemical, physical, and aesthetic properties make it a material of choice in a wide range of domestic, industrial, and high-technology applications.

Alloyed with other metals, such as zinc (to form brass), aluminum or tin (to form bronzes), or nickel, for example, it can acquire new characteristics for use in highly specialized applications. In fact, society's infrastructure is based, in part, on copper.

Key Physical Properties of Copper



But copper's benefits extend beyond mechanical characteristics:

- Copper is **essential to the health** of plants, animals, and humans. Deficiencies, as well as excesses, can be detrimental to health.
- **Antimicrobial Properties**. Due to copper's antimicrobial properties, copper and copper alloy products can be used to eliminate pathogens and reduce the spread of diseases.
- **Recycling**. Copper is one of the most recycled of all metals. Virtually all products made from copper can be recycled and recycled copper loses none of its chemical or physical properties.
- **Energy Efficiency**. Copper can improve the efficiency of energy production and distribution systems.

SELECTED COPPER DEFINITIONS

- **Anode**. The positive terminal in an electrolytic cell where electrons leave a device to enter the external circuit. A copper anode at 99 percent purity will dissolve.
- **Blister**. The product of a converting furnace. It is an intermediate, more concentrated (with respect to the desired metal) material than matte, from which it is made, and is usually transferred to another furnace for further concentration.
- **Cathode**. The negative terminal in an electrolytic cell where copper is plated during electrowinning or electrolytic refining. Copper so plated is referred to as "cathode" and is generally about 99.99 percent pure.
- **Contained Copper**. Contained copper is defined as the analytical amount of copper outputted in concentrates and precipitates.
- **Copper concentrate**. A product of flotation milling. It is composed of sulfide minerals and entrained material and contains one-third each copper, iron, and sulfur. It can be processed pyrometallurgically in a smelter to produce matte or hydrometallurgically (pressure leaching) to produce pregnant leach solution, both products requiring further processing to obtain copper metal.
- **Direct melt scrap**. Direct-melt or re-melt scrap is secondary material that can be used directly in a furnace without cleanup through the use of fluxes and poling and re-refining.
- **Electrorefining**. An electrolytic refining process where less pure copper anode is dissolved and high-purity copper is plated at the cathode.
- **Electrowinning**. An electrolytic refining process where the anode is inert and rich (copper-loaded) electrolyte continually replaces lean (copper-depleted) electrolyte as copper is plated at the cathode.
- **Fire-refined copper**. The product of a fire-refining furnace. It is an intermediate, more concentrated (with respect to the desired metal) material than blister, from which it is made. Fire-refined copper contains about 99 percent copper, the exact percentage depending on the process parameters.
- **Primary copper**. Copper extracted from ores and recovered as copper metal or copper-bearing chemicals.
- **Secondary refined material**. Secondary refined material represents scrap that has been fire-refined, or that has been converted to anode at the smelter level and then electrolytically refined.
- **Solvent extraction**. A method of separating one or more metals from a leach solution by treating with a solvent that will extract the required metal, leaving the others. The metal is recovered from the solvent by further treatment.
- **Stocks**. ICSG reports refined copper stocks as those held by exchanges, consumers, producers, and governments. Merchant stocks are included where it is certain that these are nonduplicative to those already reported. Only refined products at plant sites are included. Items such as wire rods, tubes, and other semi-fabricated forms are not included.
- **Usage**. Copper usage represents refined copper used by semifabricators. Usage data is either directly reported or the ICSG estimates an **apparent usage** using the following formula: Refined copper production + refined imports - refined exports + refined beginning stocks - ending stocks.

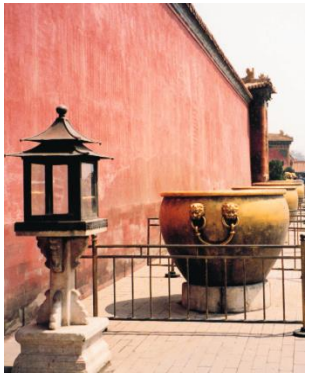
Sources: ICSG and USGS

Copper in History

Archaeological evidence demonstrates that copper was one of the first metals used by humans and was used at least 10,000 years ago for items such as coins and ornaments in Western Asia. During the prehistoric Chalcolithic Period (derived from *chalkos*, the Greek word for copper), man discovered how to extract and use copper to produce ornaments and implements. As early as the 4th to 3rd millennium BC, workers extracted copper from Spain's Huelva region.

The discovery that copper, when alloyed with tin, produces bronze, led to the Bronze Age, c. 2,500 BC. Israel's Timna Valley provided copper to the Pharaohs (an Egyptian papyrus records the use of copper to treat infections and to sterilize water). Cyprus supplied much of the Phoenician, Greek and Roman needs for copper. "Copper" is derived from the Latin *Cyprium*, literally Cyprian metal. The Greeks of Aristotle's era were familiar with brass as a valued copper alloy. In South America, the pre-Columbian Maya, Aztec and Inca civilizations exploited copper, in addition to gold and silver. During the Middle Ages, copper and bronze works flourished in China, India and Japan.

The discoveries and inventions relating to electricity and magnetism of the late 18th and early 19th centuries by scientists such as Ampere, Faraday and Ohm, and the products manufactured from copper, helped launch the Industrial Revolution and propel copper into a new era. Today, copper continues to serve society's needs. Although copper has been in use for at least 10,000 years, innovative applications for copper are still being developed as evidenced by the development of the copper chip by the semi-conductor's industry.




Images courtesy of the British Museum, the Copper Development Association and ICSG.

COPPER TODAY

The global demand for copper continues to grow: world refined usage has more than tripled in the last 50 years thanks to expanding sectors such as electrical and electronic products, building construction, industrial machinery and equipment, transportation equipment, and consumer and general products. Some of the highlights of 2023 copper production and usage are listed below. In the chapters that follow, more in-depth information is presented on copper production, trade, usage, and recycling. For the most up-to-date information on the global copper market, please visit our website at www.icsg.org.

Copper Production Highlights

Preliminary figures indicate that global **copper mine production** in 2023 reached 22.4 million tonnes. **Chile** was the largest producer of mined copper, with an output of 5.3 million tonnes.

Smelter production in 2023 reached 22.9 million tonnes. **China** was the leading producer of blister & anode in 2023, producing 11.8 million tonnes.

Refinery Production in 2023 increased to 26.5 million tonnes, including 4.5 million tonnes of secondary refined production. China was the largest producer.

Copper Usage Highlights

Refined copper usage (usage by semis plants or the first users of copper) in 2023 reached 26.5 million tonnes. **China** was also the largest consumer of refined copper in 2023 with apparent usage of around 15.5 million tonnes.

According to the International Copper Association (ICA), equipment was the largest copper end-use sector in 2023, followed by building construction and infrastructure.

New copper applications being developed include antimicrobial copper touch surfaces, lead-free brass plumbing, high-tech copper wire, heat exchangers, and new consumer products as well.

Images courtesy of CDA and Luis Hernán Herreros from www.luishernanherreros.com, © Copyright Anglo American (Faena Los Bronces y Mantos Blancos – Chile)

CHAPTER 2: COPPER RESOURCES AND LONG-TERM AVAILABILITY OF COPPER

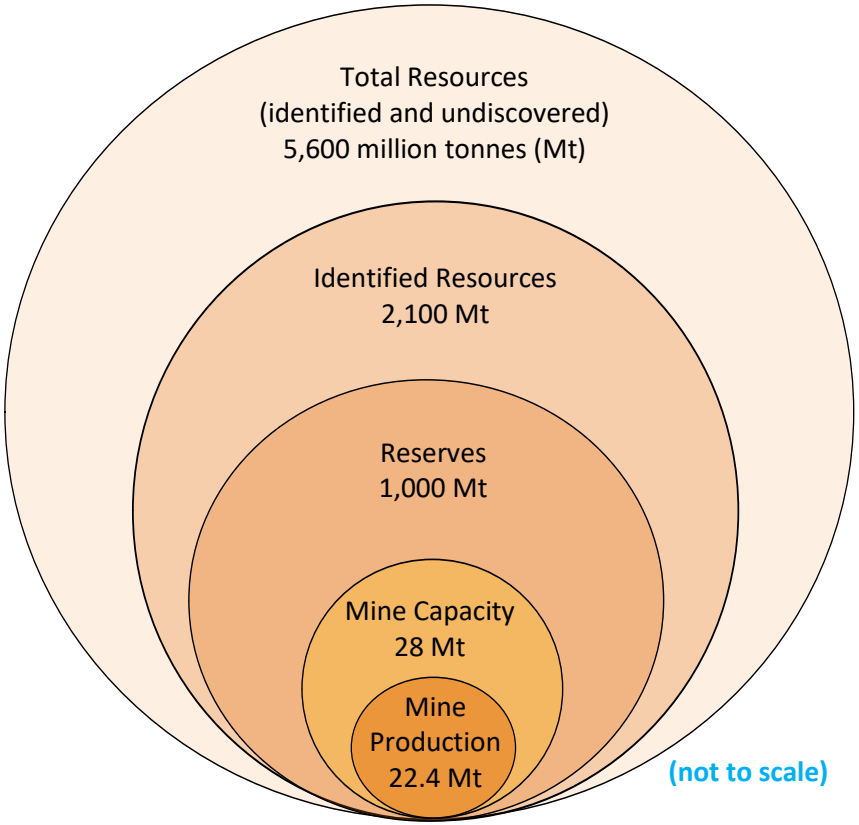
COPPER RESERVES AND RESOURCES

Typically, the future availability of minerals is based on the concept of reserves and resources. Reserves are deposits that have been discovered, evaluated and assessed to be economically profitable to mine. Resources are far bigger and include reserves, discovered deposits that are potentially profitable, and undiscovered deposits that are predicted based on preliminary geological surveys (see definitions below).

According to the United States Geological Survey (USGS), copper reserves amounted to around 1,000 million tonnes (Mt) in 2023. Identified and undiscovered copper resources were estimated in 2015 at around 2,100 Mt and 3,500 Mt, respectively (see Page 7). The latter does not consider the vast amounts of copper found in deep sea nodules and land-based and submarine massive sulfides. Current and future exploration opportunities will lead to increases in both reserves and known resources.

Definitions (https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-appendixes.pdf)
Resource: A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.
Identified Resources: Resources for which location, grade, quality, and quantity are known or estimated from specific geologic evidence. Identified resources include economic, marginally economic, and subeconomic components.
Undiscovered Resources: Resources, the existence of which are only postulated, comprising deposits that are separate from identified resources. Undiscovered resources may be postulated in deposits of such grade and physical location as to render them economic, marginally economic, or subeconomic.
Reserves: That part of the reserve base—defined as part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth—that could be economically extracted or produced at the time of determination. The term "reserves" need not signify that extraction facilities are in place and operative.

2023 World Copper Reserves & Mine Production [1/]
(undiscovered resources not including deep sea nodules and land-based and submarine massive sulfides - contained copper)

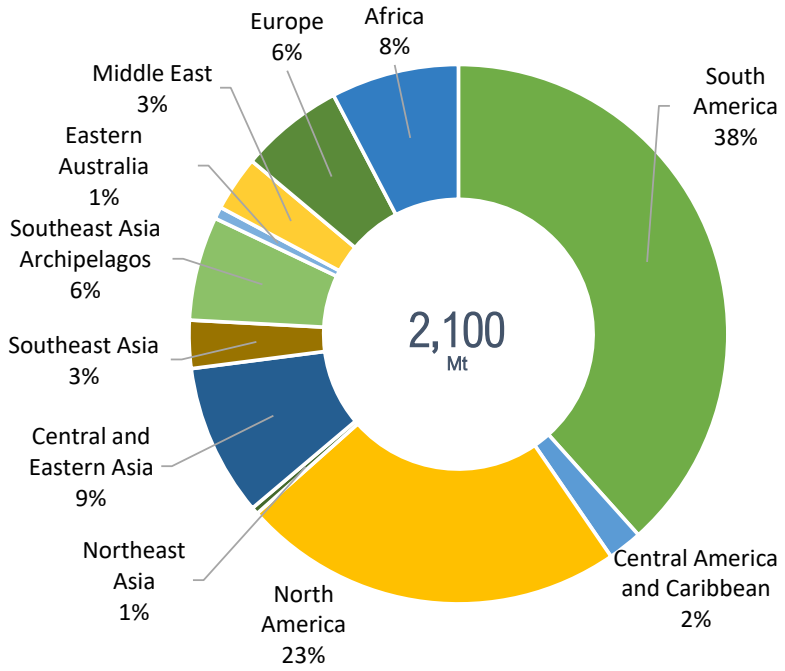


1/ Source: USGS (resources/reserves data) and ICSG (capacity/production data)

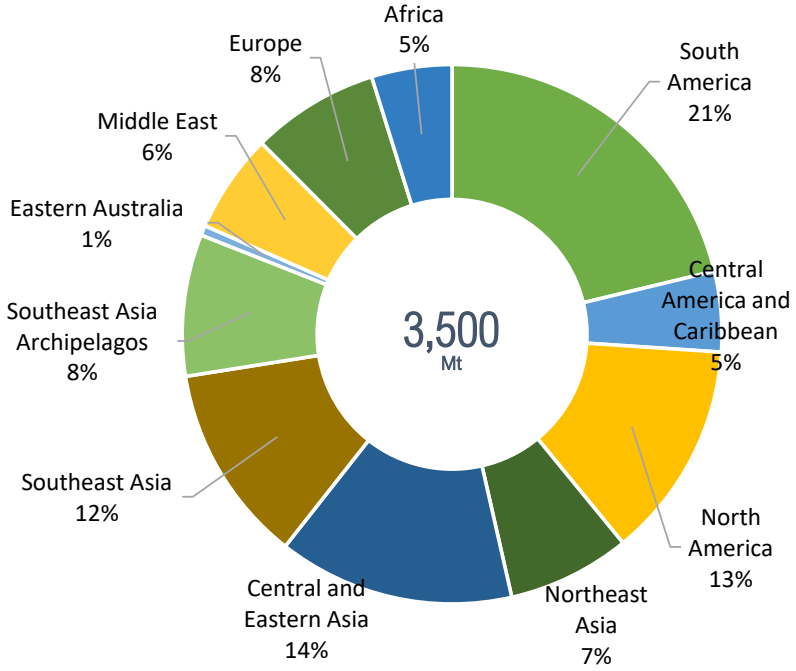
Global Distribution of Identified and Undiscovered Copper Resources in Porphyry and Sediment-hosted Stratabound Copper Deposits [1/]

In 2015, the U.S. Geological Survey (USGS) completed the first-ever global assessment of undiscovered copper resources for the two most significant sources of global copper supply: porphyry copper deposits and sediment-hosted stratabound copper deposits. This assessment revealed that an estimated 3,500 million metric tons (Mt) of undiscovered copper may exist globally, with 3,100 Mt from porphyry deposits and 400 Mt from sediment-hosted deposits. This is in addition to the 2,100 Mt of identified copper resources, of which 74% come from porphyry, 10% from sediment-hosted stratabound and the remaining 16% from other type deposits. Combined, the identified and undiscovered copper resources sum to 5,600 Mt.

A. Identified Copper Resources, world total = 2,100 Mt



B. Undiscovered Copper Resources, World total = 3,500 Mt

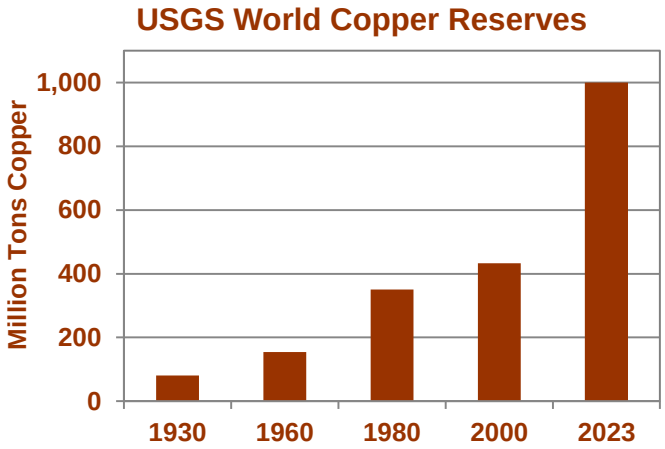


1/ Assessment of Undiscovered Copper Resources of the World, 2015. Scientific Investigations Report 2018–5160 Version 1.2, Dec 2021. https://pubs.er.usgs.gov/publication/sir20185160

ARE WE GOING TO RUN OUT OF COPPER? [1]

It is highly improbable. Since 1960, there have always been, on average, 38 years of reserves, and significantly greater amounts of known resources (USGS data). In addition, recycling, innovation, and mining exploration continue to contribute to the long-term availability of copper.

Despite increased demand for copper produced from ore in recent years, increases in reserves have grown, and there is more identified copper available to the world than at any other time in history.



In the period 2000-2023, 418 million tonnes of copper have been mined. In that same period, however, reserves have grown by 567 million tonnes to 1,000 million tonnes of copper. This reflects additional exploration, technological advances, and the evolving economics of mining.

Technology has a key role to play in addressing many of the challenges faced by new copper production. Known and as yet unknown innovations will ensure new mine production continues to provide vital copper supplies.

In addition, copper recycling plays an important role in copper availability since today's primary copper is tomorrow's recycled material. Unlike other commodities such as energy or food, copper is not "consumed". Copper is one of the few raw materials that can be recycled repeatedly without any loss of performance, and key stakeholders such as policy-makers, scrap collectors, copper producers, and recyclers must all focus on ensuring that yesterday's metal is recycled and reused.

While this will ensure a progressive move towards a more sustainable economy, the loop cannot be completely closed for two reasons. Firstly, demand will continue to increase due to population growth, product innovation, and economic development. Secondly in most applications, copper stays in use for decades.

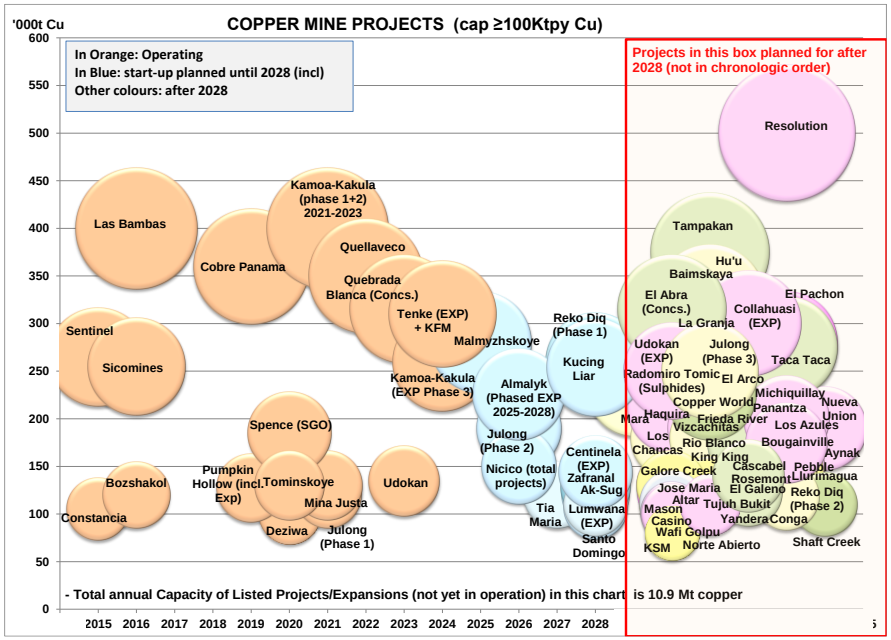
Consequently, meeting future metals demand will continue to require a combination of primary raw materials, coming from mines, as well as recycled materials, while innovative policies and technology should continue to contribute to improvements in recycling performance and resource efficiency.

Based on the latest knowledge on geological availability and continuous industry innovation there are good reasons to believe that copper will continue to be a vital and positive contributor to society well into the future.

1/ Based on the International Copper Association briefing note on copper's long-term availability. See http://copperalliance.org/about-copper/long-term-availability/

Future Copper Supply – Mine Projects

There are several copper mine projects currently being evaluated or developed that will contribute to future supply growth. In its Directory of Copper Mines, Smelters, and Refineries, the ICSG presents detailed global information on copper mine projects currently under development and in feasibility or exploration status. The Chart below, based on information in the latest Directory, presents the major copper mine projects with annual production capacities above 100,000 tonnes of copper that together represent an additional annual production capacity of around 10 million tonnes of copper. There are also many smaller projects currently being developed or assessed.



Source: ICSG Directory of Copper Mines, Smelters, and Refineries

Deep Sea Minerals Exploration

The oceans represent around 70% of the world's surface and the ocean floor is believed to contain important mineral resources including copper. To meet increasing copper demand, the discovery and exploration of new resources will be crucial and sea floor deposits could represent an important opportunity for additional supply. However, the challenge is to be able to exploit those deposits while respecting all environmental standards and turning them into economically viable operations.

In light of new developments in science and technology, as well as changing economic circumstances, commercial interest in deep sea mining has grown in recent years The International Seabed Authority (ISA) (www.isa.org.jm) is the entity that issues regulations and procedures to regulate prospecting, exploration, and exploitation of marine minerals in the international seabed area (defined as the seabed and subsoil beyond the limits of national jurisdiction). ISA is mandated under the UN Convention on the Law of the Sea to organize, regulate, and control all mineral-related activities in the international seabed area for the benefit of mankind as a whole. In so doing, the ISA has a duty to ensure the effective protection of the marine environment from harmful effects that may arise from deep-seabed-related activities.

ICSG has identified three off-shore copper projects that could be producing in the near future: the Solwara 1 project located in the Bismarck Sea, Papua New Guinea, the polymetallic nodules project in the Clarion-Clipperton Zone (CCZ) of the Pacific Ocean, and the manganese nodules project in Japan's exclusive economic zone in the Pacific Ocean.

CHAPTER 3: COPPER PRODUCTION

HOW IS COPPER PRODUCED?

Geologists look for signs and anomalies that would indicate the presence of a mineral deposit. Under the right geological, economic, environmental, and legal conditions, mining can proceed.

Primary copper production starts with the extraction of copper-bearing ores. There are three basic ways of copper mining: surface, underground mining, and leaching. Open-pit mining is the predominant mining method in the world.

After the ore has been mined, it is crushed and ground followed by a concentration by flotation. The obtained copper concentrates typically contain around 30% of copper, but grades can range from 20 to above 40 percent. In the following smelting process, sometimes preceded by a roasting step, copper is transformed into a “matte” containing 50-70% copper. The molten matte is processed in a converter resulting in a so-called blister copper of 98.5-99.5% copper content. In the next step, the blister copper is fire-refined in the traditional process route, or, increasingly, re-melted and cast into anodes for electro-refining.

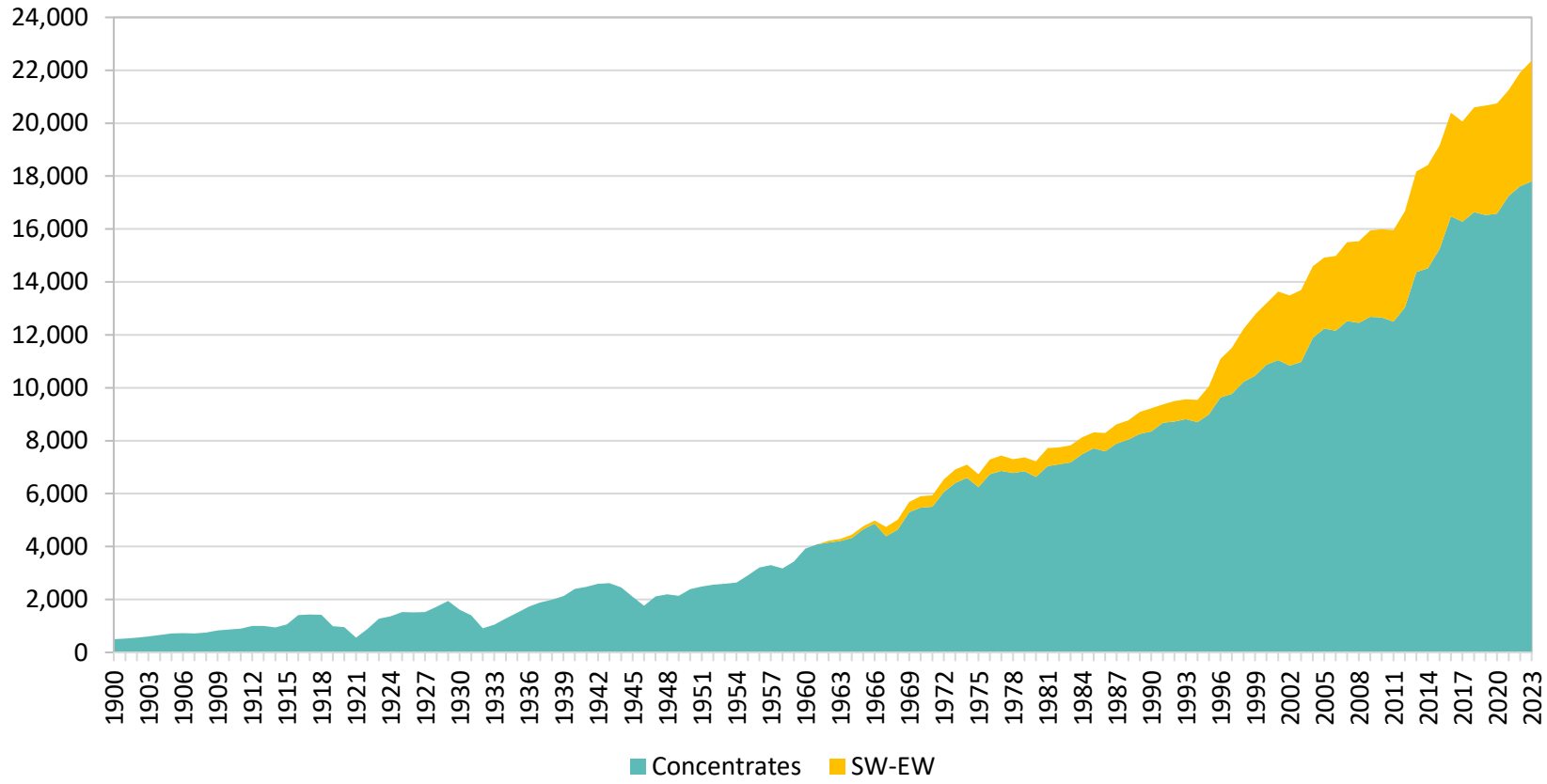
The output of electro-refining is refined copper cathodes, assaying over 99.99% of copper.

Alternatively, in the hydrometallurgical route, copper is extracted from mainly low-grade oxide ores and also some sulfide ores, through leaching (solvent extraction) and electrowinning (SX-EW process). The output is the same as through the electro-refining route - refined copper cathodes. ICSG estimates that in 2023, copper production from SX-EW represented around 20.4% of total copper mine production.

Refined copper production derived from mine production (either from metallurgical treatment of concentrates or SX-EW) is referred to as “primary copper production”, as obtainable from a primary raw material source. However, there is another important source of raw material which is scrap. Copper scrap derives from either metal discarded in semis fabrication or finished product manufacturing processes (“new scrap”) or obsolete end-of-life products (“old scrap”). Refined copper produced from recycled scrap is categorized as "secondary copper production.". Secondary producers use processes similar to those employed for primary production. ICSG estimates that in 2023, at the refinery level, secondary copper refined production reached 16.9% of total copper refined production.

COPPER MINE PRODUCTION: WORLD COPPER MINE PRODUCTION, 1900-2023

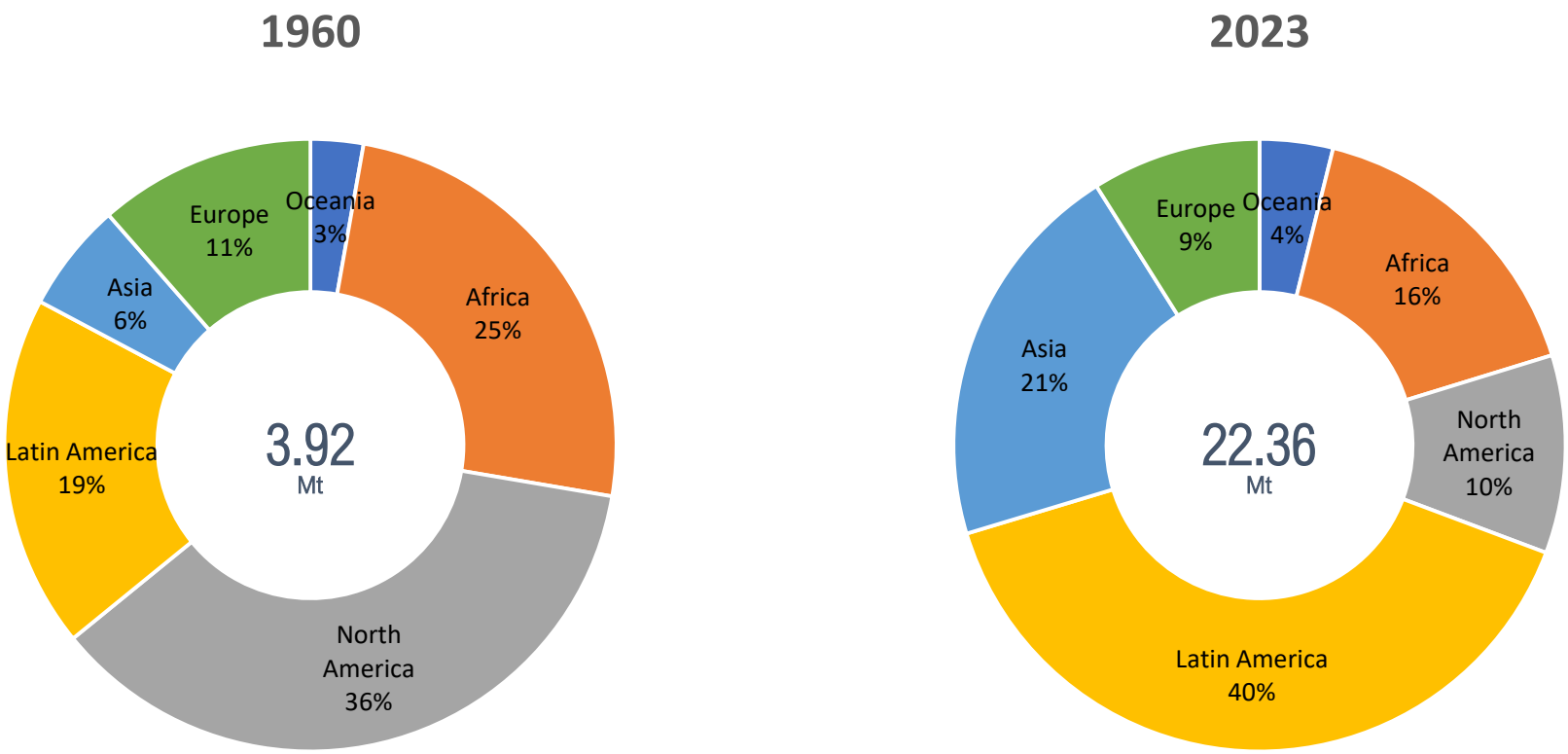
Thousand metric tonnes of copper
Source: ICSG



Since 1900, when world production was less than 500 thousand tonnes of copper, world copper mine production has grown by 3.14% per annum to 22.4 million tonnes in 2023. SX-EW production, virtually non-existent before the 1960s, reached 4.6 million tonnes in 2023.

Share of Copper Mine Production by Region, 1960 versus 2023

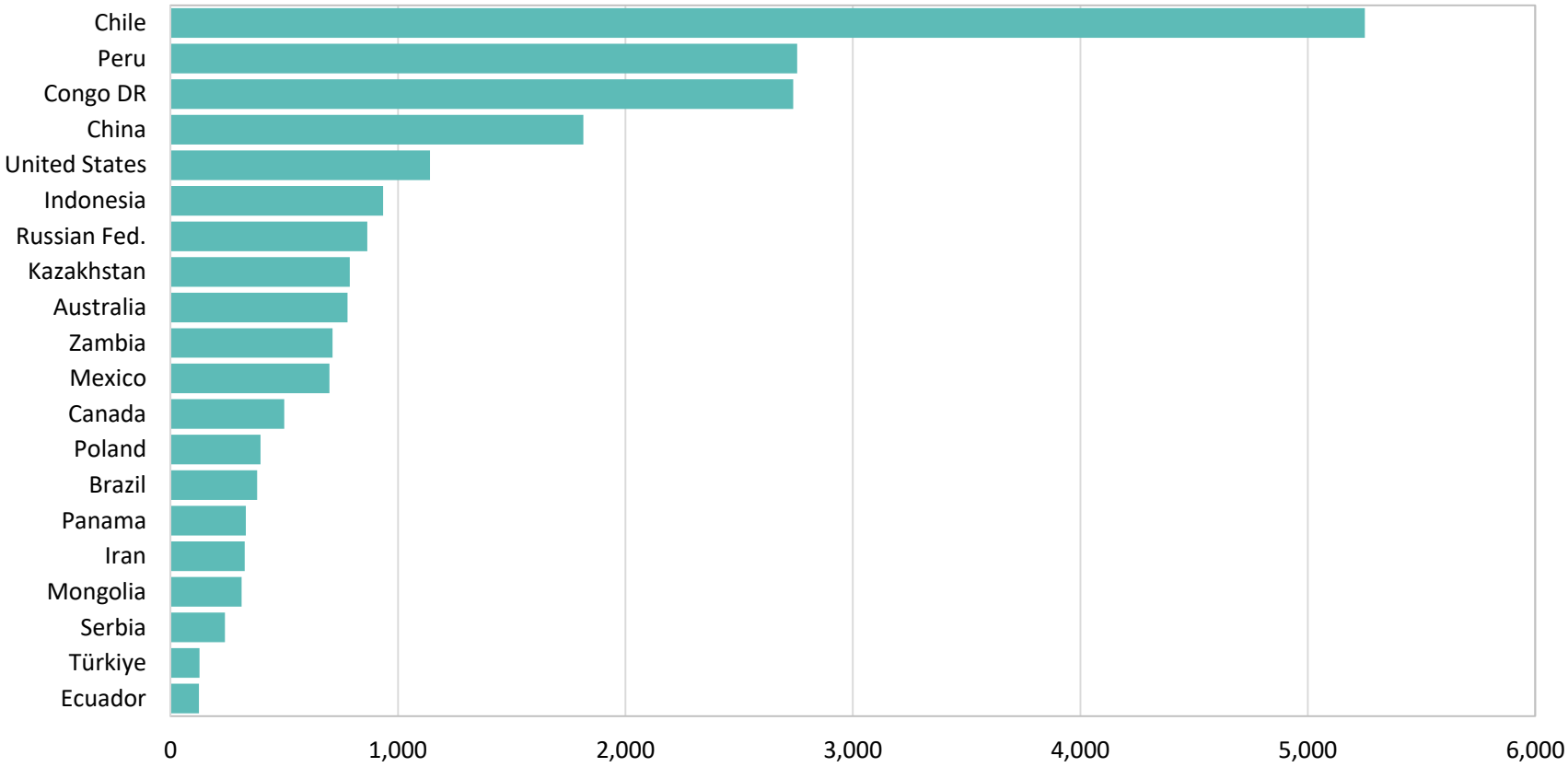
Source: ICSG



Copper mine production in Latin America has surged from less than 750,000 tonnes in 1960 to 8.9 million tonnes in 2023, now accounting for 40% of the global total. Asia has also seen significant growth, with its share of global mine production rising from 6% to 21% over the same period. In contrast, North America's share has decreased from 36% to 10%.

Copper Mine Production by Country: Top 20 Countries in 2023

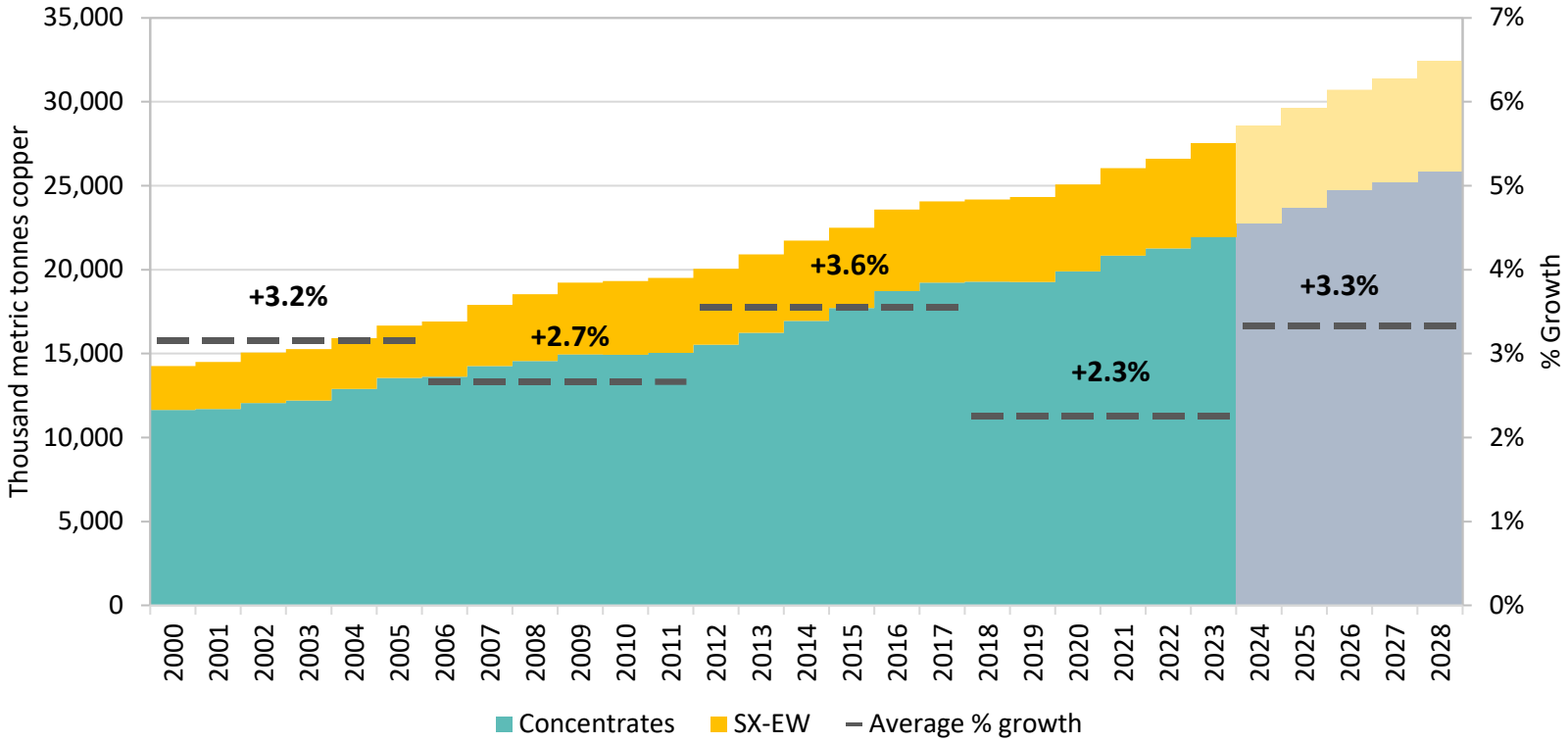
Thousand metric tonnes of copper
Source: ICSG



In 2023, Chile contributed nearly a quarter of global copper mine production, with an output of 5.3 million tonnes. Peru, which has experienced a significant surge in copper mine production since 2015, accounted for 12% of the world's output. The Democratic Republic of the Congo has also demonstrated strong performance in recent years and is projected to surpass Peru as the second-largest producer next year.

TRENDS IN COPPER MINING CAPACITY, 2000-2028

Thousand metric tonnes of copper (bars) and Annual percentage change (dashed line)
Source: ICSG Directory of Copper Mines, Smelters, and Refineries – August 2024 Edition [1/]



Copper mining capacity is estimated to reach 32.4 million tonnes by 2028, with 20% coming from SX-EW and 80% from concentrates. This will be 18% higher than the global capacity of 27.5 million tonnes recorded in 2023. Growth in copper mine capacity is expected to average 3.3% per year going forward as new capacity is added at existing and some new operations. The capacity utilization rate, which is the ratio between production and capacity, stood at 81% in 2023.

Note: Capacity data reflects production capabilities not necessarily production forecasts
1/ Available for sale - See our Publications Order Form on Page 61

TOP 20 OPERATING COPPER MINES BY CAPACITY (BASIS 2024)

Thousand metric tonnes of copper

Source: ICSG Directory of Copper Mines, Smelters, and Refineries – August 2024 Edition [/1]

Rank	Mine	Country	Owners	Source	Capacity
1	Escondida	Chile	BHP (57.5%), Rio Tinto Corp. (30%), Japan Escondida (12.5%)	Concs & SX-EW	1350
2	Grasberg	Indonesia	PT Freeport Indonesia (PT Inalum and the provincial/regional government 51.2% and Freeport-McMoRan Inc 48.8%)	Concentrates	800
3	Collahuasi	Chile	Anglo American (44%), Glencore plc (44%), Mitsui (8.4%), JX Holdings (3.6%)	Concentrates	600
4	Morenci	United States	Freeport-McMoRan Inc 72%, 28% affiliates of Sumitomo Corporation	Concs & SX-EW	570
5	Cerro Verde	Peru	Freeport-McMoRan Copper & Gold Inc. 53.56%, Compañia de Minas Buenaventura 19.58%, Sumitomo 21%	Concs & SX-EW	550
5	Kamoa-Kakula	Congo, DR	Ivanhoe Mines (39.6%), Zijin Mining Group (39.6%), Crystal River Global Limited (0.8%), Government of the Democratic Republic of Congo (20%)	Concentrates	550
7	Buenavista del Cobre (former Cananea)	Mexico	Grupo Mexico	Concs & SX-EW	535
8	Antamina	Peru	BHP (33.75%), Teck (22.5%), Glencore plc (33.75%), Mitsubishi Corp. (10%)	Concentrates	450
8	Tenke Fungurume	Congo, DR	China Molybdenum Co., Ltd 56%, affiliate of BHR Partners (Chinese private equity firm) 24%, Gecamines 20%	SX-EW	450
10	El Teniente	Chile	Codelco	Concs & SX-EW	401
11	Cobre Panama	Panama	First Quantum Minerals Ltd 90%, Korea Panama Mining Corp. (LS-Nikko Copper Inc. and Korean Resources Corporation) 10%	Concentrates	400
11	Las Bambas	Peru	MMG (62.5%), Guoxin International Investment Corporation Limited (22.5%), CITIC Metal Co., Ltd. (15%)	Concentrates	400
11	Los Pelambres	Chile	Antofagasta Plc (60%), Nippon Mining (25%), Mitsubishi Materials (15%)	Concentrates	400
11	Polar Division (Norilsk/ Talnakh Mills)	Russia	Norilsk Nickel	Concentrates	400
15	Chuquicamata	Chile	Codelco	Concs & SX-EW	370
16	Quellaveco	Peru	Anglo American 60%, Mitsubishi Corp. 40%	Concentrates	350
17	Bingham Canyon	United States	Kennecott (Rio Tinto)	Concentrates	310
18	Kamoto	Congo	Katanga Mining Ltd (86.33% Glencore plc) 75%, Gecamines 25%	SX-EW	300
18	Sentinel	Zambia	First Quantum Minerals Ltd	Concentrates	300
18	Spence	Chile	BHP	Concs & SX-EW	300

Note: Capacity data reflects production capabilities not necessarily production forecasts

1/ Available for sale - See our Publications Order Form on Page 61

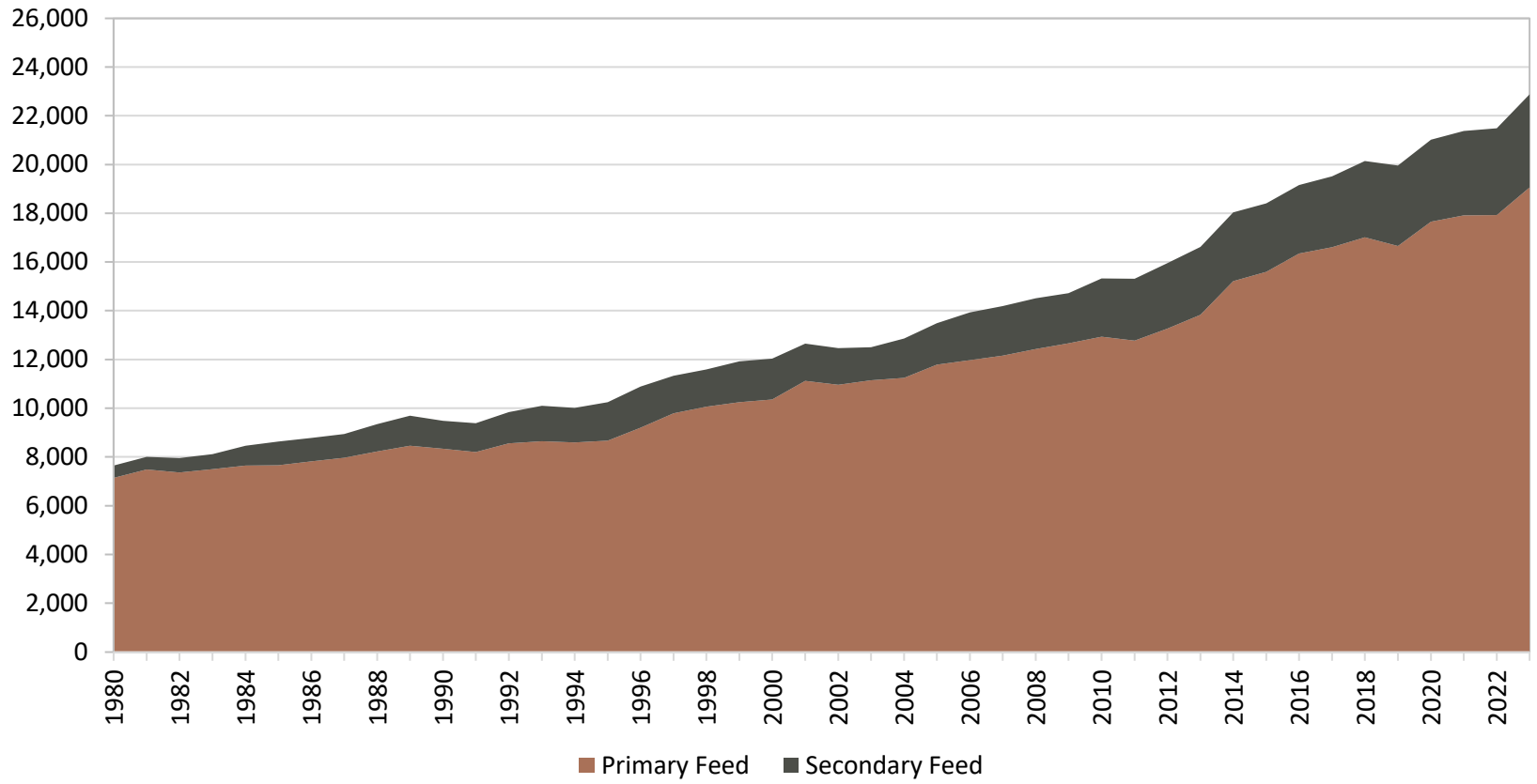
Constraints on Copper Supply

With copper concentrate in strong demand, there has been growing interest in understanding the obstacles that can prevent copper mine supply from coming on-stream. Below are some of the operational and financial constraints identified from a study undertaken by the ICSG. For more information about ICSG research related to constraints on copper supply, please contact the ICSG Secretariat at mail@icsg.org.

- Declining ore grades: a serious issue in developed copper areas such as the USA and Chile
- Project finance: prolonged economic and price volatility may have significant impact on cost of capital
- Tax & investment regimes: recent research indicates these are less important than geological endowments
- Other cost issues: lower capital expenditure may have adverse long-term effects on copper supply; operating cost escalation
- Water supply: a critical issue in dry mining districts
- Energy: coal is the fuel chosen to power main copper mines and processes. Climate change may increase costs
- Other environmental issues: governments are becoming more aware of the impact of mining on the surrounding environment in recent years. In countries like Peru and the Philippines, the relationship with indigenous community is also a key factor
- Resource nationalism: It has become a priority for certain governments to develop their mineral resources that have not been exploited until now. While willing to develop their natural resources, countries might be seeking to extract strong revenue flows from them. It will be important to balance royalty/taxation levels with the need to encourage capital investment to develop their rising industries
- Sulfuric acid supply and price: 16% cost factor for SX-EW projects
- Skilled labor: open labor markets would help address this constraint
- Labor strikes: tend to increase when refined prices are high and GDP is growing faster, but tend to be longer and less frequent otherwise
- High domestic costs if there is “Dutch disease” (resulting in higher exchange rates due in part to strong exports)
- Rate between imported inputs and domestic input costs affected by the currency strength of the producer
- Political risks: Security and transport accessibility is crucial to mine operation

COPPER SMELTER PRODUCTION: WORLD COPPER SMELTER PRODUCTION, 1980-2023

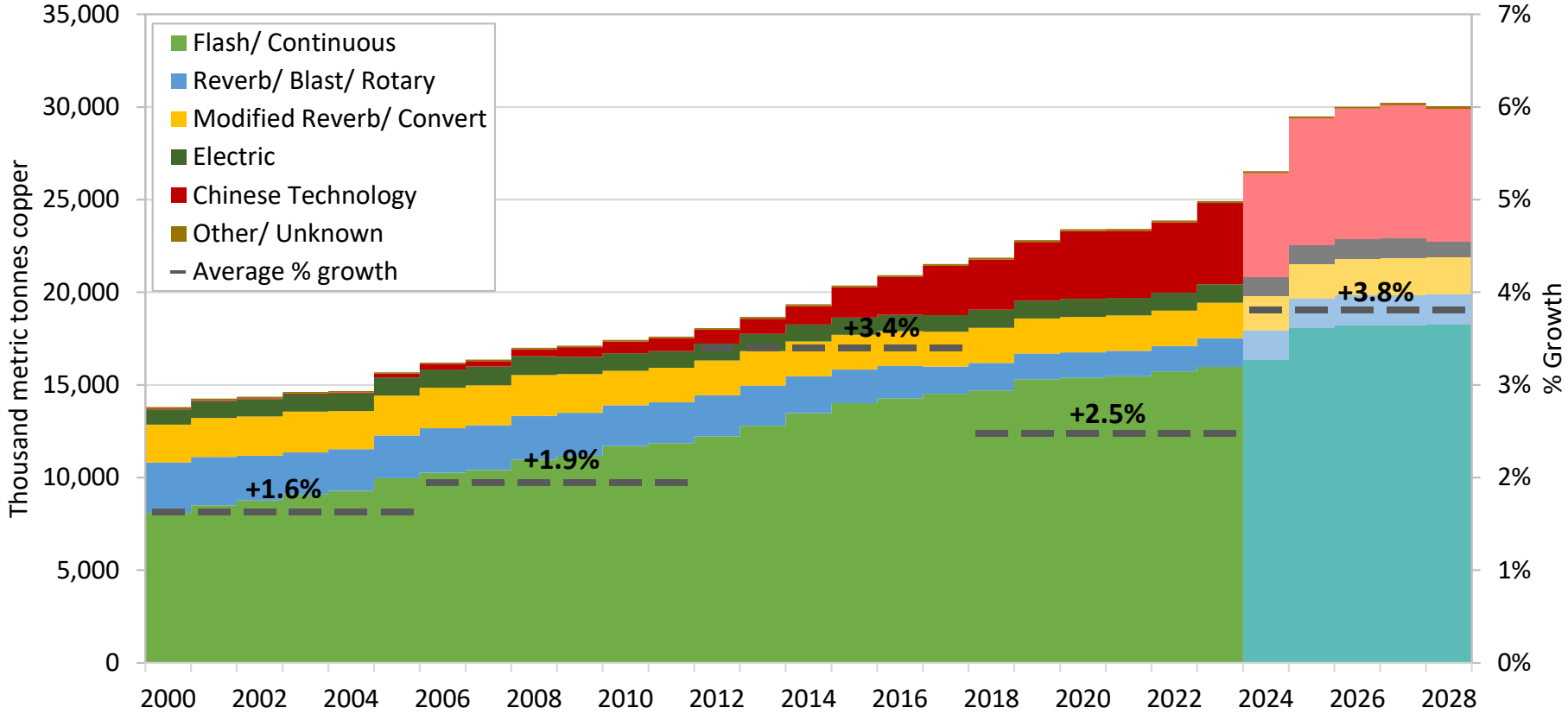
Thousand metric tonnes of copper
Source: ICSG



Smelting is the pyrometallurgical process used to produce copper metal. In 2023, world copper smelter production reached 22.9 million tonnes of copper. Recently, the trend to recover copper directly from ores through leaching processes has been on the increase. Primary smelters use mine concentrates as their main source of feed (although some use copper scrap as well). Secondary copper smelters use copper scrap as their feed.

TRENDS IN COPPER SMELTING CAPACITY, 2000-2028

Thousand metric tonnes of copper (bars) and Annual percentage change (dashed line)
Source: ICSG Directory of Copper Mines, Smelters, and Refineries – August 2024 Edition /1

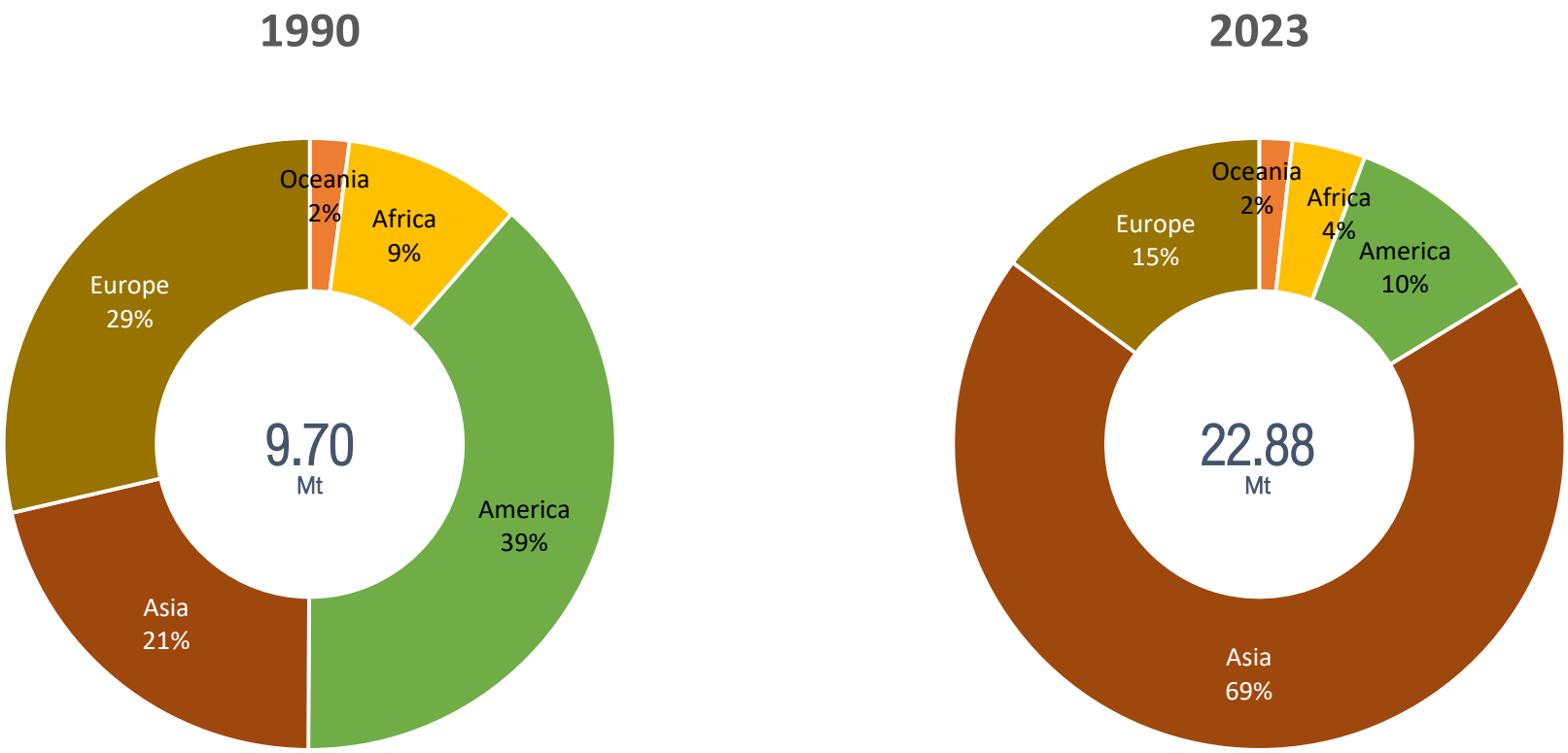


The use of Flash/Continuous technology accounted for 59% of total copper smelting capacity in 2000. This share rose to 64% in 2023. It is expected to remain above 60% until 2028. There has also been a rapid expansion of Chinese technology, which first emerged in 2004, and is expected to represent around 24% by 2028. Going forward, an average annual percentage growth of 3.8% in total smelting capacity is also expected through 2028.

Note: Capacity data reflects production capabilities not necessarily production forecasts
1/ Available for sale - See our Publications Order Form on Page 61

SHARE OF COPPER SMELTER PRODUCTION BY REGION, 1990 VERSUS 2023

Source: ICSG

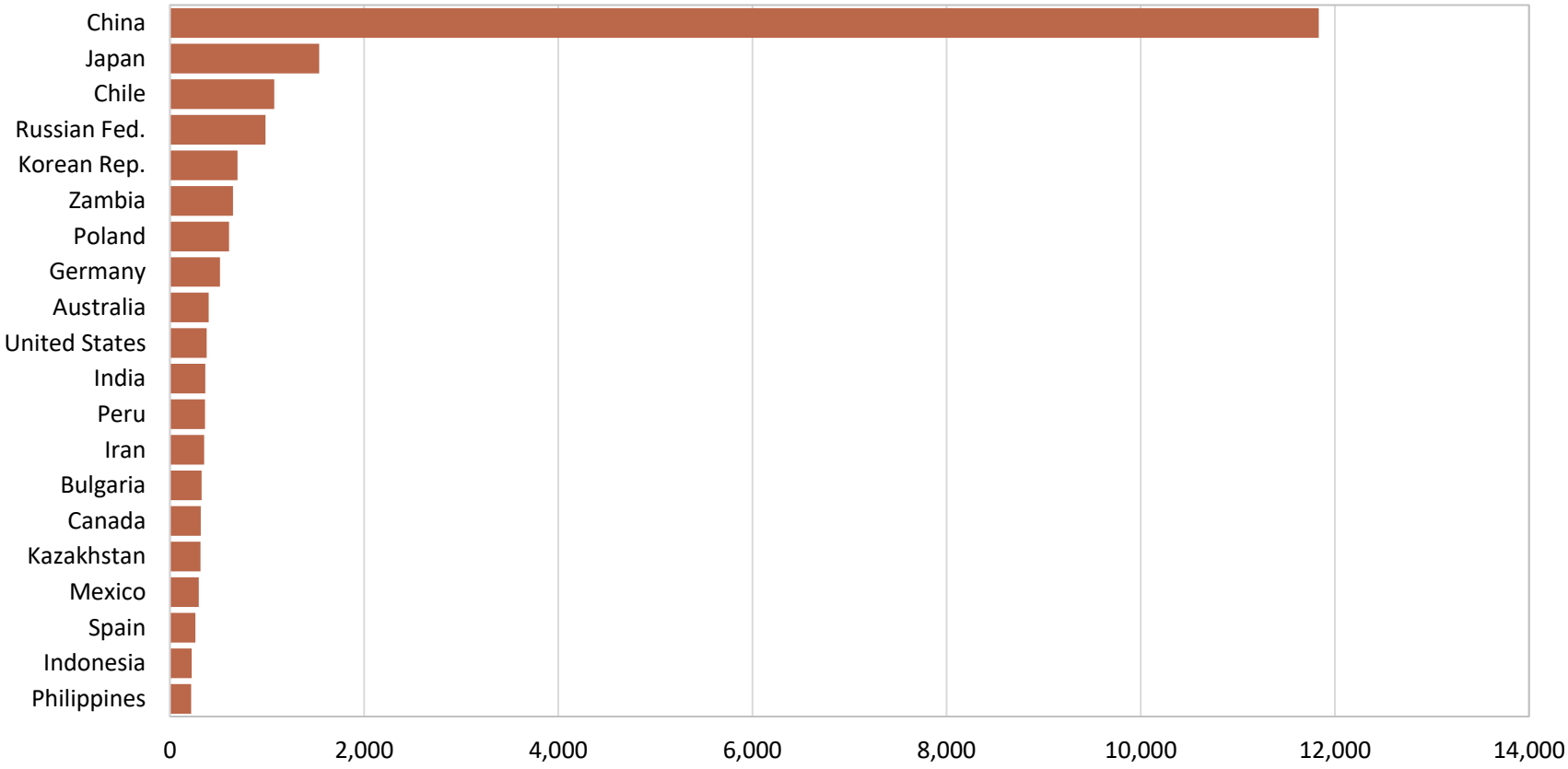


As smelter production in China expanded rapidly, Asia's share of global copper smelter production skyrocketed from 21% to 69%, between 1990 and 2023, highlighting its rise as the dominant region in copper smelting. Conversely, the Americas' share experienced a sharp decline from 39% to 10%, while Europe also decreased from 29% to 15% in the same period.

COPPER SMELTER PRODUCTION BY COUNTRY: TOP 20 COUNTRIES IN 2023

Thousand metric tonnes of copper

Source: ICSG



In 2023, China accounted for more than 50% of world copper smelter production, followed by Japan (7%), Chile (5%) and Russia (4%).

TOP 20 OPERATING COPPER SMELTERS BY CAPACITY (BASIS 2024)

Thousand metric tonnes of copper

Source: ICSG Directory of Copper Mines, Smelters, and Refineries – August 2024 Edition /1

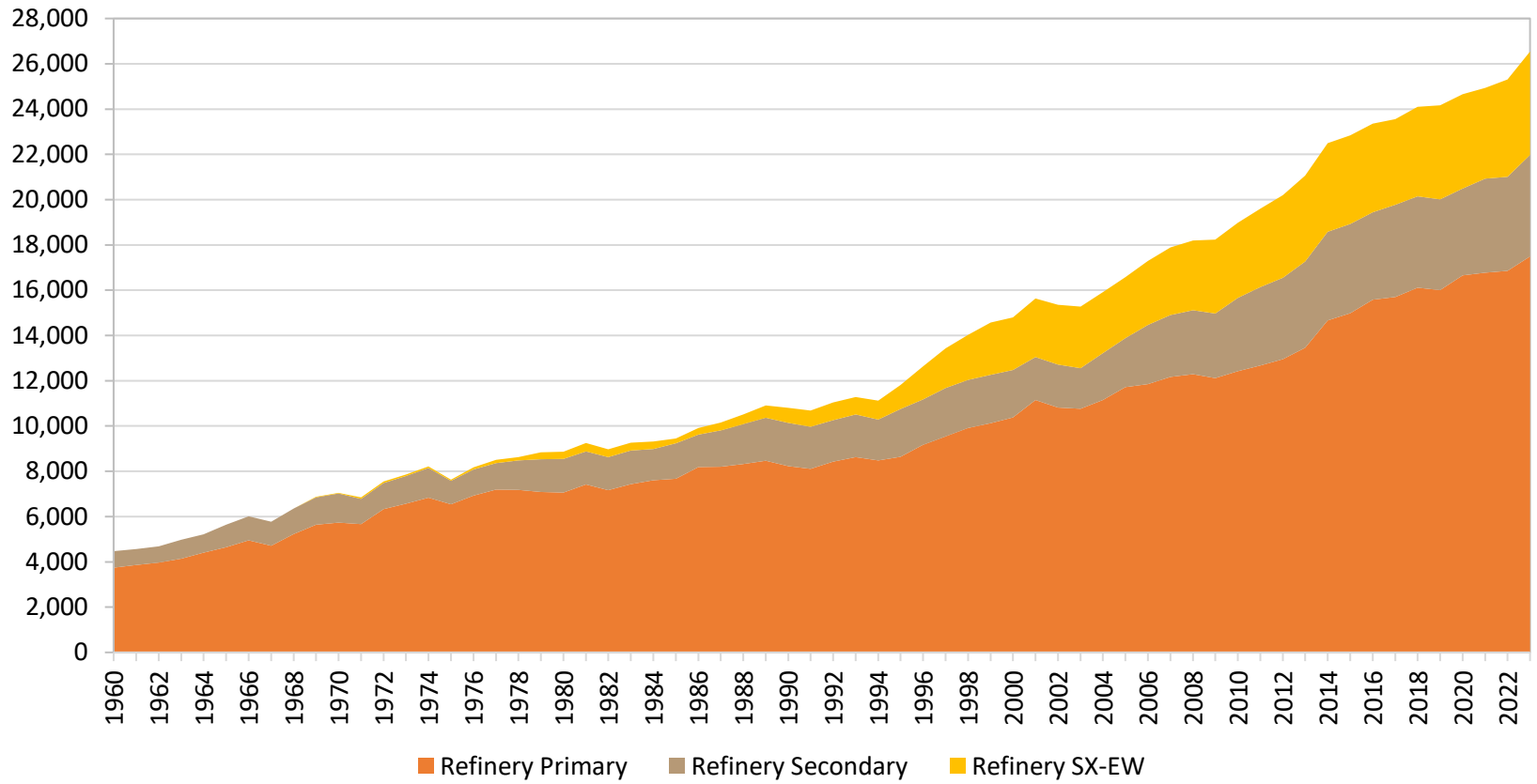
Rank	Smelter	Country	Operator/Owner(s)	Process	Capacity
1	Nanko Copper (smelter)	China	Guangxi Nanko Copper Co.	Side-Blown	675
2	Guixi (smelter)	China	Jiangxi Copper Group 43.72%,Hong Kong Securities Clearing Company Ltd. 31.03%, Other companies and private 25.25%	Flash Smelter	520
3	Adani (smelter)	India	Adani Entreprises	Flash Smelter	500
4	Jinguan (Flash Smelter)	China	Tongling Nonferrous Metals 100%	Flash Smelter	480
5	Chuquicamata (smelter)	Chile	Codelco	Outokumpu/ Teniente Converter	450
5	Hamburg	Germany	Aurubis	Outokumpu, Contimelt, Electric	450
5	Saganoseki (smelter)	Japan	JX Nippon Mining & Metals Co., Ltd.	Outokumpu Flash	450
5	Toyo (smelter)	Japan	Sumitomo Metal Mining Co. Ltd.	Outokumpu Flash	450
9	Birla Copper (Dahej)	India	Birla Group (Hidalco)	Outokumpu Flash, Ausmelt, Mitsubishi Continuous	420
10	Chifeng Yunnan (smelter)	China	Chifeng Yunnan Copper (Yunnan Copper 45%, Chifeng state-owned capital operation Co.,Ltd. 45%, Jinfeng Copper 10%)	Side-Blown	400
10	Chinalco Southeast Copper (smelter)	China	Chinalco (Yunan Copper 60%, Fujian Investment & Development Group Co.,Ltd. 40%)	Flash Smelter	400
10	El Teniente (Caletones)	Chile	Codelco	Reverberatory/ Teniente Conv.	400
10	Guangxi Xingyue	China	Guangxi Xingyue Material Technology	Side-Blown	400
10	Hongsheng Copper	China	Yangxin Hongsheng Copper Industry Company Limited (Daye Nonferrous 52%,China NO.15 Metallurgical Construction Group 24%, Huangshi Xingang Development Co., Ltd 16%, Huangshi State Asset Management Co., Ltd 8%)	Flash Smelter	400
10	Jinchuan (Fangchenggang smelter)	China	Jinchuan Group 70%,Trafigura Pte Ltd. 20%, Trafigura Investment (China) Co., Ltd.10%	Flash smelter	400
10	Manyar (smelter)	Indonesia	PT-FI (Freeport-McMoRan Inc. 48.76%)	Outokumpu Flash	400
10	Norilsk (Nikelevy, Medny)	Russia	Norilsk Nickel	Reverb, Electric, Vanyukov	400
10	Shandong Fangyuan (smelter)	China	Dongying Development Zone Fangyuan nonferrous metal industry and Trade Co., Ltd 71.39%, Singapore Meijin jeweler 28.61%	Bottom-Blown	400
10	Sterlite Smelter (Tuticorin)	India	Vedanta	Isasmelt Process	400
10	Yanggu C&D (smelter)	China	Xiamen C&D 51%	Outokumpu Flash	400

Note: Capacity data reflects production capabilities not necessarily production forecasts

1/ Available for sale - See our Publications Order Form on Page 61

REFINED COPPER PRODUCTION: WORLD REFINED COPPER PRODUCTION, 1960-2023

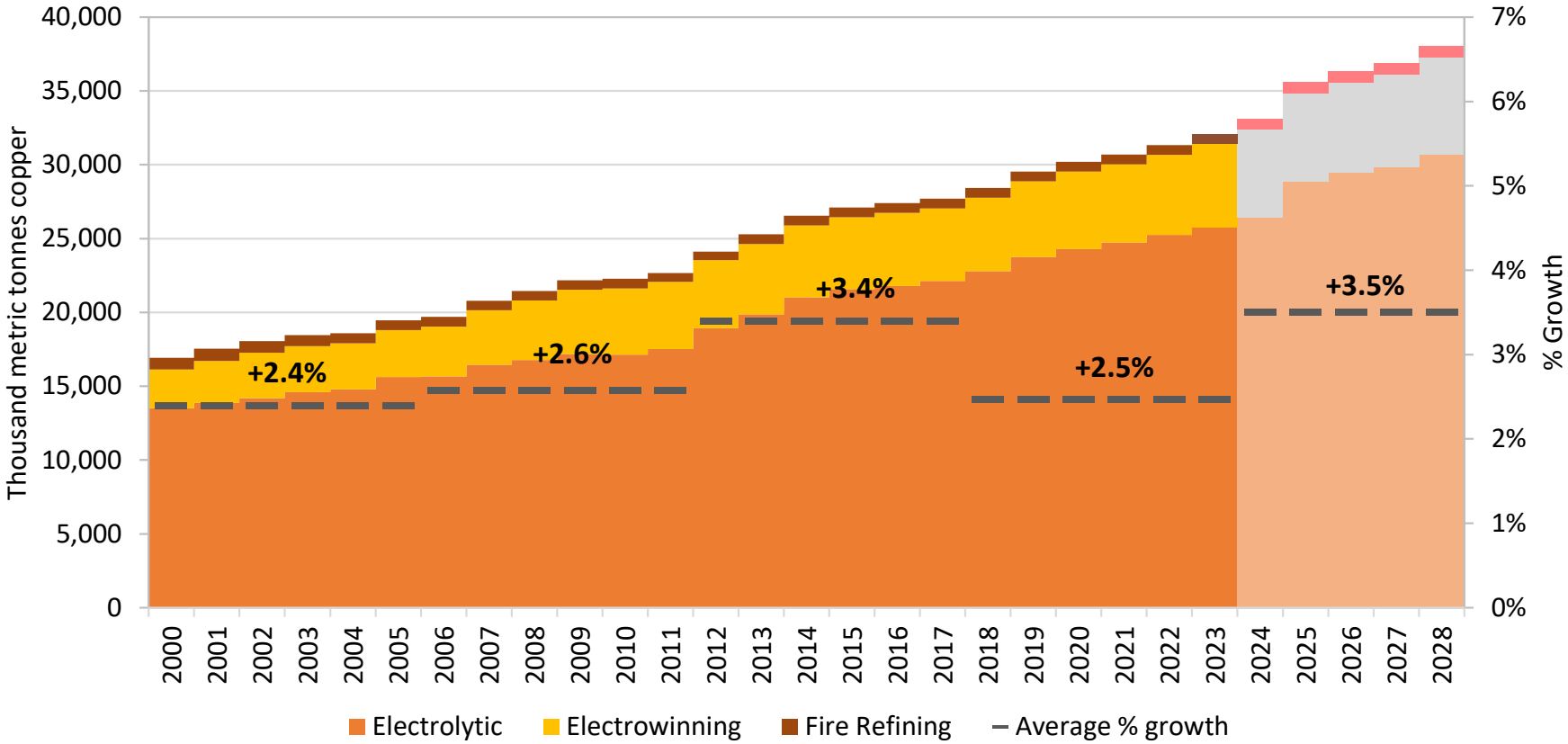
Thousand metric tonnes of copper
Source: ICSG



With the emergence of solvent extraction-electrowinning (SX-EW) technology, refined copper produced from leaching ores has increased from less than 1% of world refined copper production in the late 1960's to 17% of world output in 2023. World copper refined production amounted to 26.5 million tonnes in 2023.

TRENDS IN COPPER REFINING CAPACITY, 2000-2028

Thousand metric tonnes of copper (bars) and Annual percentage change (dashed line)
Source: ICSG Directory of Copper Mines, Smelters, and Refineries – August 2024 Edition /1

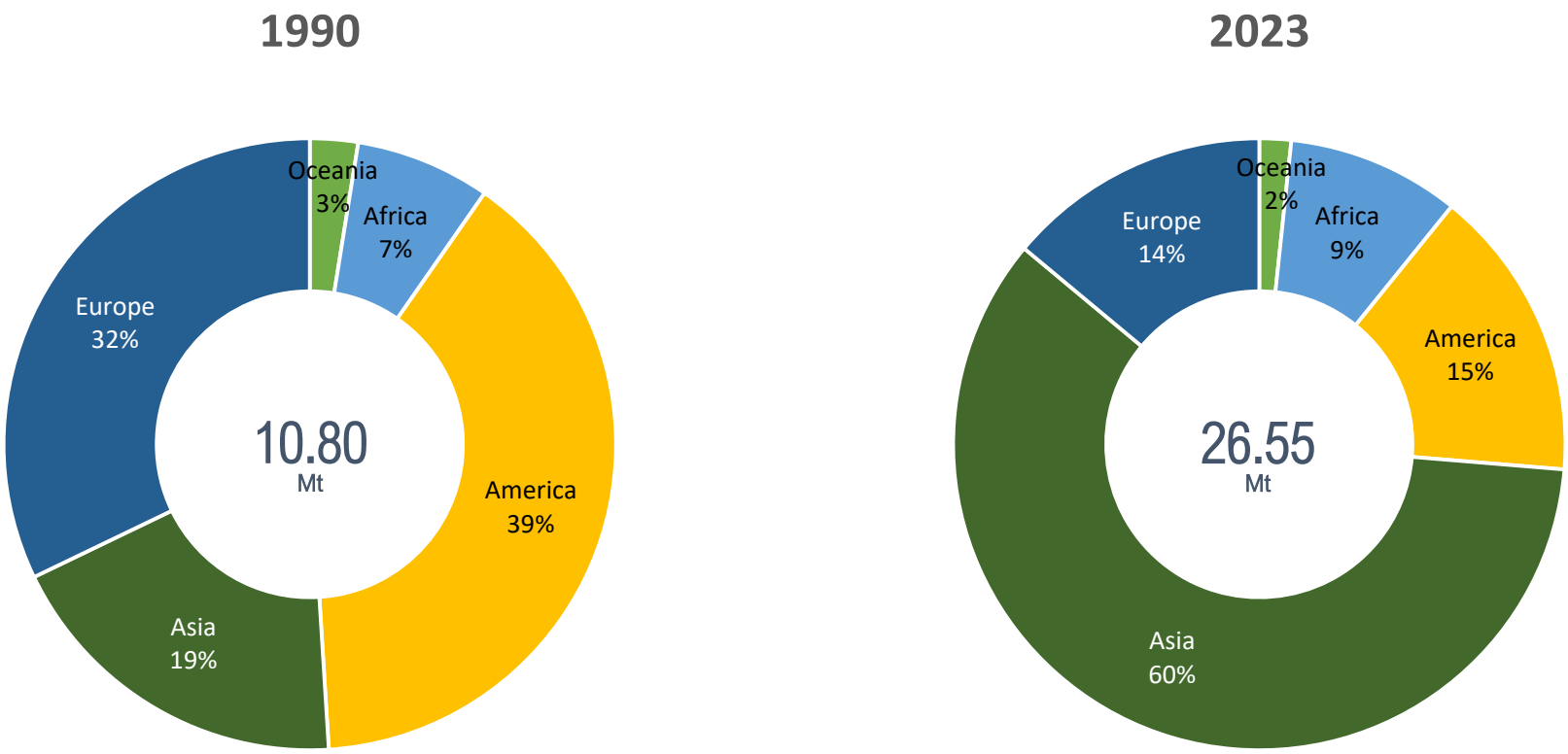


This chart shows world copper refinery capacity by refining process. The ratio between production and capacity is called the capacity utilization rate. The world refinery capacity utilization rate was around 82.7% in 2023. Going forward, a 3.5% annual average growth in global refining capacity is expected through 2028.

Note: Capacity data reflects production capabilities not necessarily production forecasts
1/ Available for sale - See our Publications Order Form on Page 61

SHARE OF REFINED COPPER PRODUCTION BY REGION, 1990 VERSUS 2023

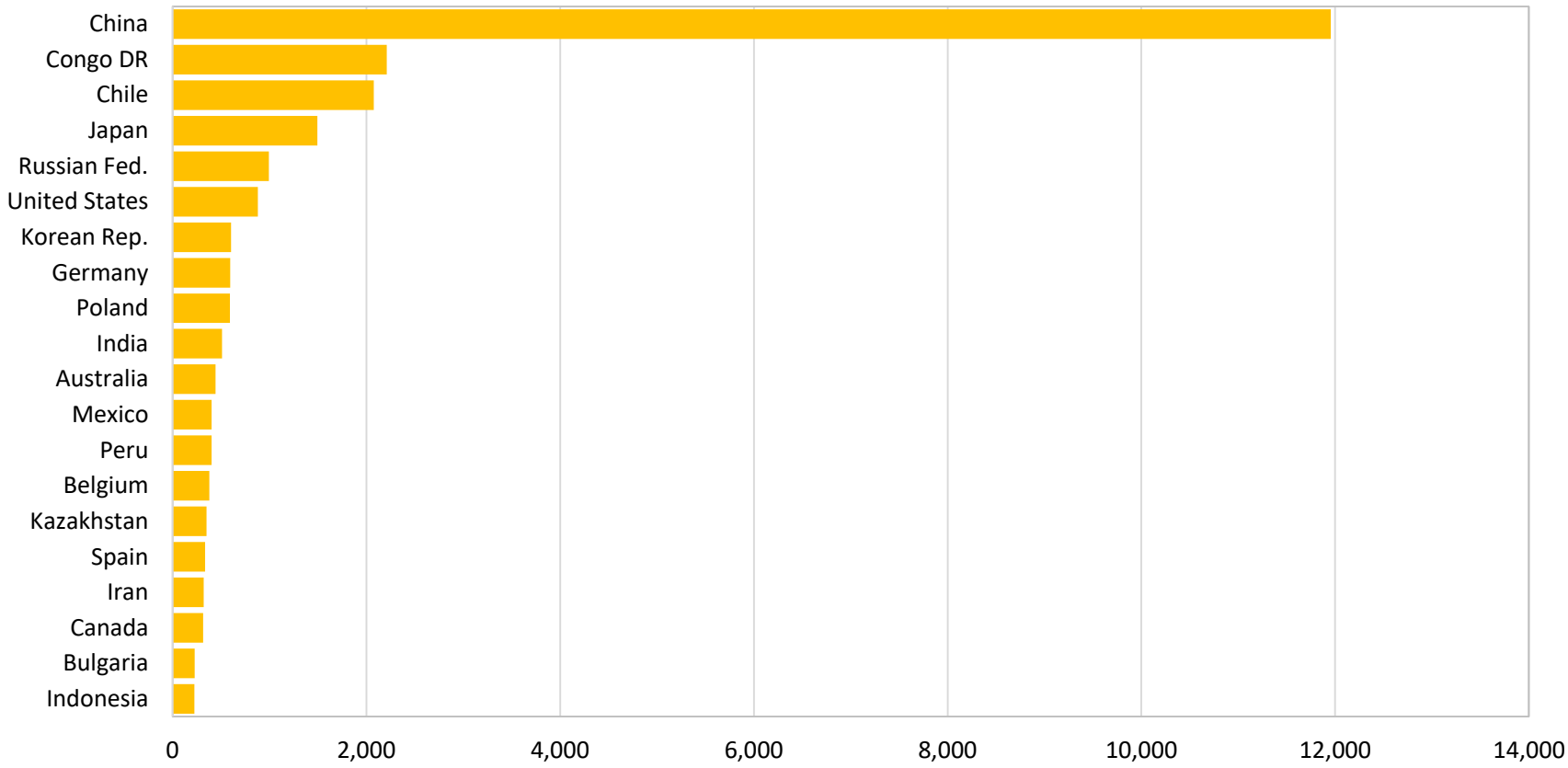
Source: ICSG



Asia's share of global refined copper production has surged dramatically, thanks to China, rising from 19% in 1990 to a dominant 60% in 2023, reflecting its growing influence in the copper industry. Conversely, the Americas' share has sharply declined from 39% to just 15% over the same period, and Europe's contribution has also dropped significantly from 32% to 14%. Africa has seen a modest increase, moving from 7% to 9%.

Refined Copper Production by Country: Top 20 Countries in 2023

Thousand metric tonnes of copper
Source: ICSG



In 2023, China accounted for 45% of global copper refined production, with an output of 12 million tonnes. The Democratic Republic of the Congo showed a great performance, surpassing Chile as the second-largest producer in 2023.

TOP 20 OPERATING COPPER REFINERIES BY CAPACITY (BASIS 2024)

Thousand metric tonnes of copper

Source: ICSG Directory of Copper Mines, Smelters, and Refineries – August 2024 Edition /1

Rank	Refinery	Country	Owner(s)	Process	Capacity
1	Guixi	China	Jiangxi Copper Corporation	Electrolytic	1100
2	Jinchuan Gansu (refinery)	China	Gansu state-owned Assets Investment Group 47.97%, Gansu Government State-owned Assets Supervision and Administration Commission 12.89%, The China Development Bank 13.53%, Other investors 25.61%	Electrolytic	700
2	Shandong Fangyuan (refinery)	China	Dongying Development Zone Fangyuan nonferrous metal industry and Trade Co., Ltd 71.39%, Singapore Meijin jeweler 28.61%	Electrolytic	700
4	Daye/ Hubei (refinery)	China	China Non-ferrous Metals Mining Group Company Ltd (CNMC) 57.99%,Hubei Hongtai State-owned Captial Investment Operation Group 38.56%, Daye City Construction 2.32%, Huangshi State Asset Management Co., Ltd and Yangxin County State Asset management Co., Ltd 1.13%	Electrolytic	600
4	Yanggu C&D (refinery)	China	Xiamen C&D 51%	Electrolytic	600
6	Birla	India	Birla Group (Hidalco)	Electrolytic	500
6	Adani (refinery)	India	Adani Entreprises	Electrolytic	500
7	Jinchuan (Fangchenggang refinery)	China	Jinchuan Group 70%, Trafigura Pte Ltd. 20%, Trafigura Investment (China) Co., Ltd.10%	Electrolytic	495
8	Heding Copper (refinery)	China	Jiangxi Copper 40%, Fuchunjiang Smelting 40%,Xuancheng Quanxin Mining Co., Ltd.15%, One of Fuchuanjiang's branches 5%	Electrolytic	470
9	Jinlong (Tongdu) (refinery)	China	Tongling Nonferrous Metals 61.41%, Sumitomo Metal & Mining Co. Ltd. 27.07%, Sumitomo Corporation 7.86%, Pingguo Aluminium Company 3.67%.	Electrolytic	460
9	Pyshma Refinery	Russia	Uralelectromed (UMMC (Urals Mining & Metallurgical Co.))	Electrolytic	460
11	Amarillo	United States	ASARCO (Grupo Mexico)	Electrolytic	450
11	Chinalco Southeast Copper (refinery)	China	Yunan Copper 60%, Fujian Investment & Development Group Co.,Ltd. 40%	Electrolytic	450
11	Chuquicamata Refinery	Chile	Codelco	Electrolytic	450
11	Tenke Fungurume (SX-EW)	Congo	China Molybdenum Co., Ltd 56%, affiliate of BHR Partners (Chinese private equity firm) 24%, Gecamines 20%	Electrowinning	450
11	Toyo (refinery)	Japan	Sumitomo Metal Mining Co. Ltd.	Electrolytic	450
17	Las Ventanas	Chile	Codelco	Electrolytic	440
17	Onsan Refinery I	Korean Republic	LS-Nikko Co. (LS, Nippon Mining)	Electrolytic	440
19	Hamburg (refinery)	Germany	Aurubis	Electrolytic	416
20	El Paso (refinery)	United States	Freeport-McMoRan Copper & Gold Inc.	Electrolytic	415

Note: Capacity data reflects production capabilities not necessarily production forecasts

1/ Available for sale - See our Publications Order Form on Page 61

Chapter 4: Corporate Social Responsibility (CSR) in Mining

What is Corporate Social Responsibility?

Corporate Social Responsibility refers to the continuing commitment by "the corporation" to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large.

The basis of CSR is rooted in Archie Carroll's "Pyramid of Corporate Social Responsibility"[1] In this Pyramid a corporation has four types of responsibilities. The first and most obvious is the economic responsibility to be profitable. The second is the legal responsibility to obey the laws set forth by society. The third, which is closely linked to the second, is ethical responsibility. That is to do what is right even when business is not compelled to do so by law. The fourth is philanthropic responsibility. It is best described by the resources contributed by corporations toward social, educational, recreational and/or cultural purposes.

Why is CSR Important?

Corporate Social Responsibility has been around since the 1950s, but its importance and practice took hold much later. With mining activity increasing, CSR is more relevant than ever before.

CSR programs usually invest in infrastructure (potable water, electricity, schools, roads, hospitals, hospital equipment, drainage repairs, etc.), building social capital (providing high-school and university education, workshops on gender issues, information on family planning, improving hygiene, etc.), and building human capital (training local people to be employed by the mining business or to provide outsourced services, promote and provide skills on microbusiness, aquaculture, etc.).[2]

Mining companies engage in CSR programs because:

- From a community perspective, they provide a mechanism of compensation for the social and environmental costs associated with mining. CSR is also a means through which a mining company can be seen to actively give back to the community.
- Mining companies also benefit from CSR programs by building better relations with the local communities in which they operate. The economic risks of not having good community relations include project delays and even mine closures.

1/ Based on Archie Carroll's research on The Pyramid of Corporate Social Responsibility: Toward the Moral Management of Organizational Stakeholders (1991)
2/ https://www.miningfacts.org/communities/what-is-corporate-social-responsibility/

CHAPTER 5: COPPER TRADE

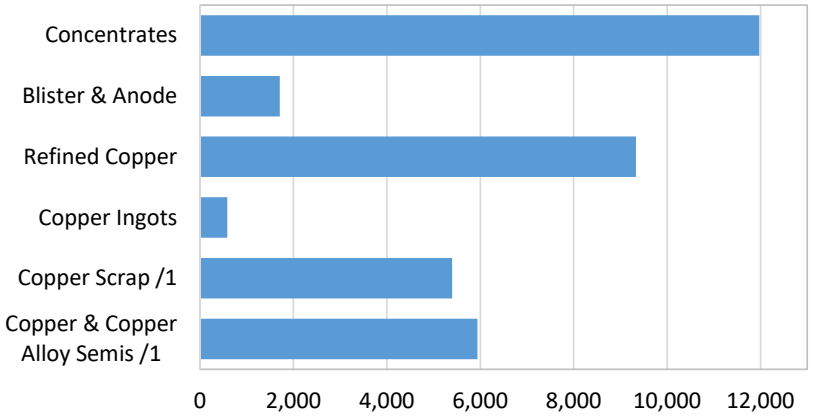
Copper products across the value chain are traded internationally. Often, countries where upstream copper production capacity exceeds downstream production capacity will import the raw materials needed to meet their production needs, and vice versa. **Major product categories** of copper traded internationally include:

- Copper concentrates
- Copper blister and anode
- Copper cathode and ingots
- Copper scrap and
- Copper semis

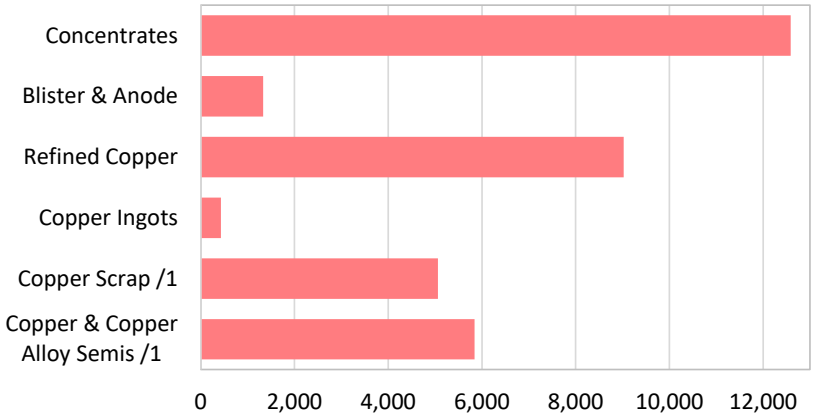
Copper powders and compounds are also traded globally, but typically in much smaller quantities. In addition, copper is contained in end-use products that are traded globally including automobiles, appliances, electronic equipment, and other products. Changes in trade regulations, such as import duties or export quotas, can significantly impact the international trade of copper. For more information about the international trade of copper and changes in regulations that can affect the trade of copper, please contact the ICSG Secretariat at mail@icsg.org

1/ Gross weight.
2/ Exports and Imports might not match due to transit time, under-reporting or product misclassification

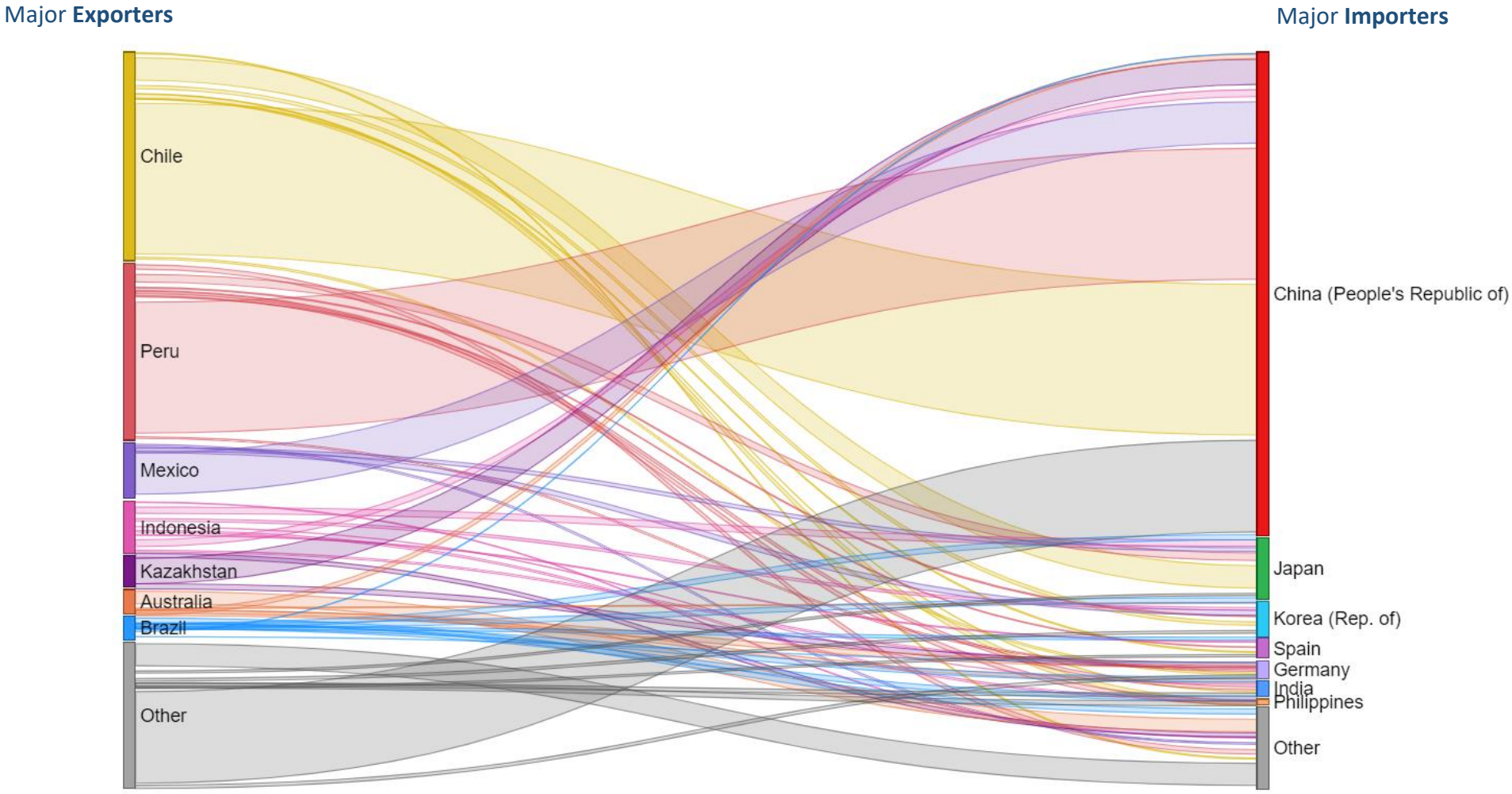
World Copper Imports by Product Category, 2023 /2
Thousand metric tonnes copper (unless otherwise noted)
Source: ICSG



World Copper Exports by Product Category, 2023 /2
Thousand metric tonnes copper (unless otherwise noted)
Source: ICSG

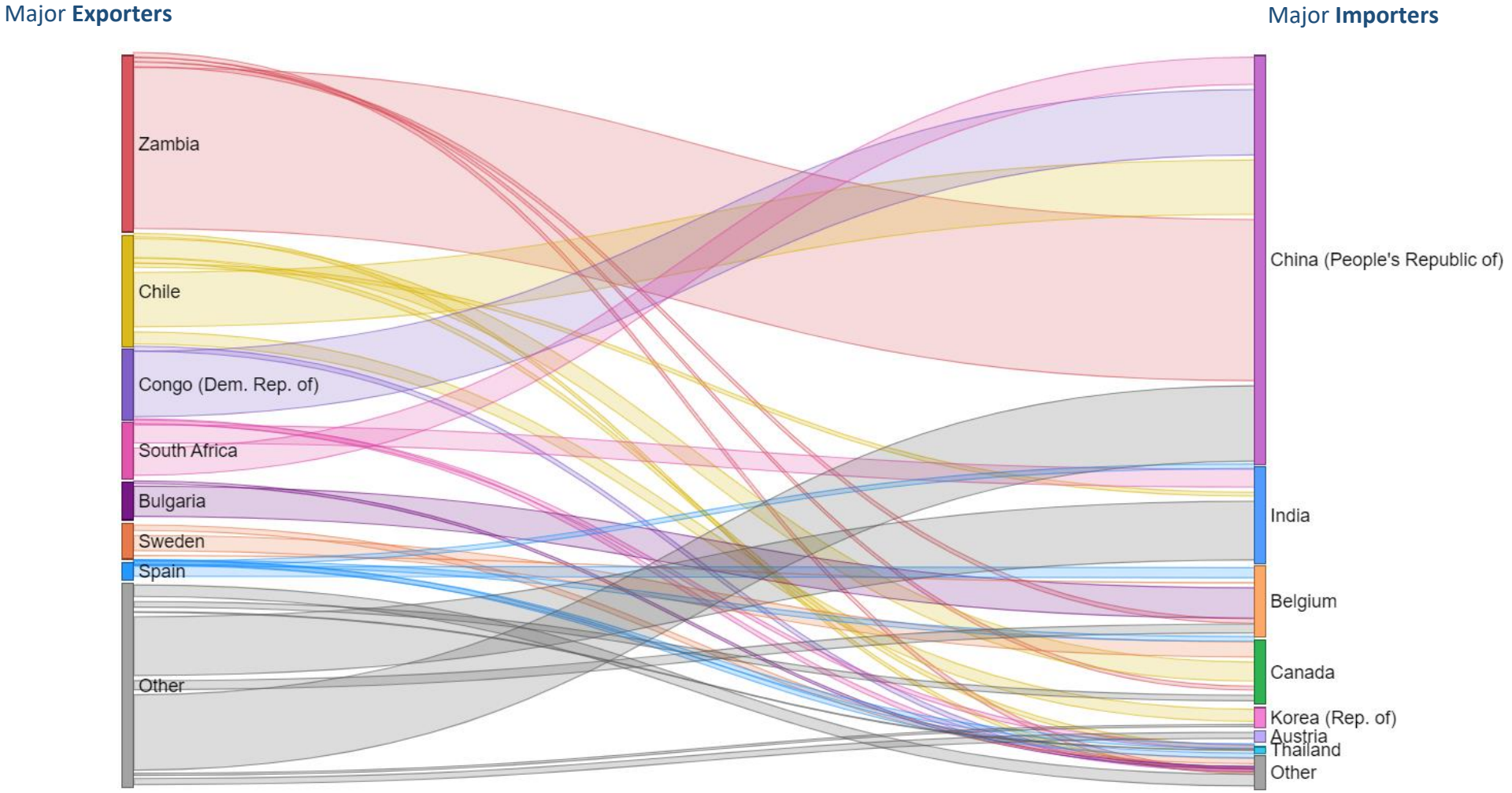


INTERNATIONAL TRADE FLOW OF COPPER ORES AND CONCENTRATES, 2023 [1]



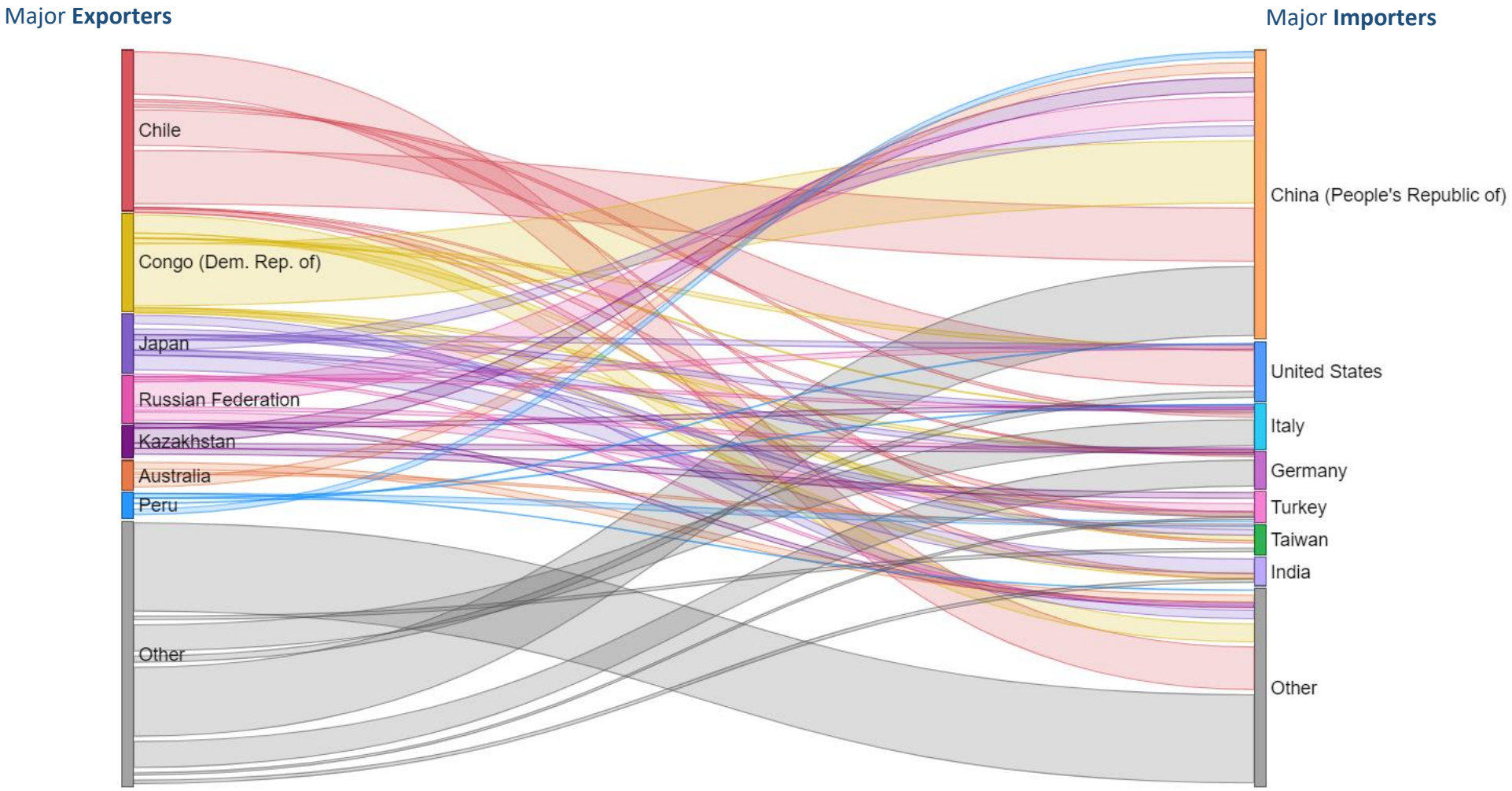
1/ Detailed trade matrices are available in ICSG Statistical Yearbook.

INTERNATIONAL TRADE FLOW OF COPPER BLISTER AND ANODES, 2023 [1]



1/ Detailed trade matrices are available in ICSG Statistical Yearbook.

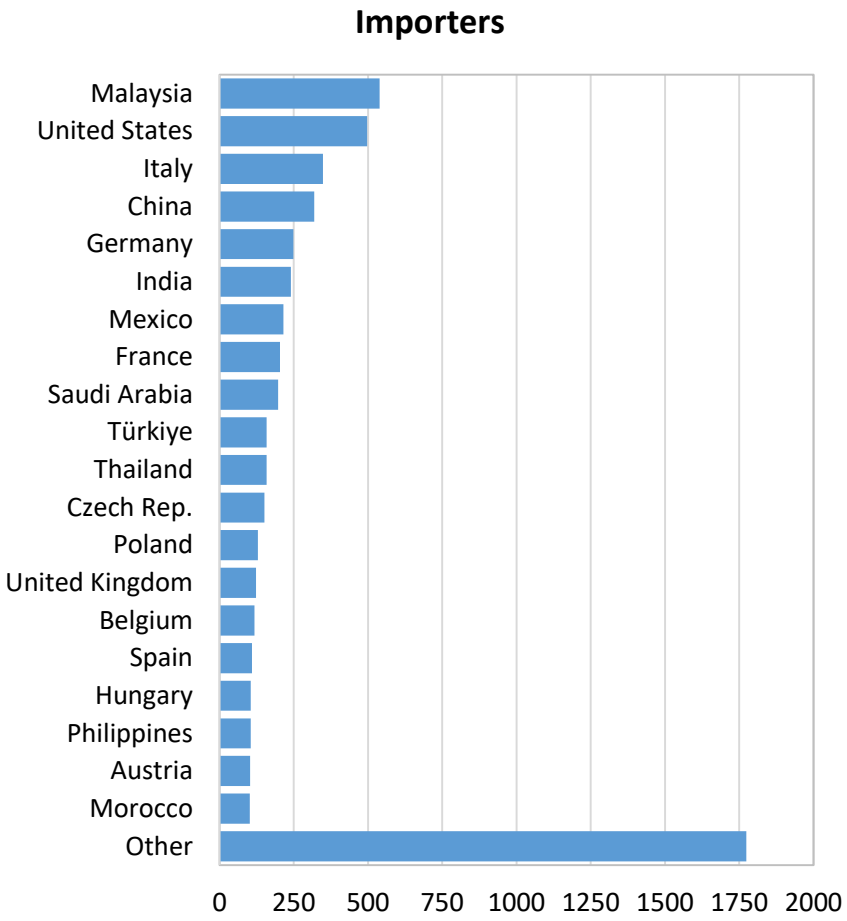
INTERNATIONAL TRADE FLOW OF REFINED COPPER, 2023 [1]

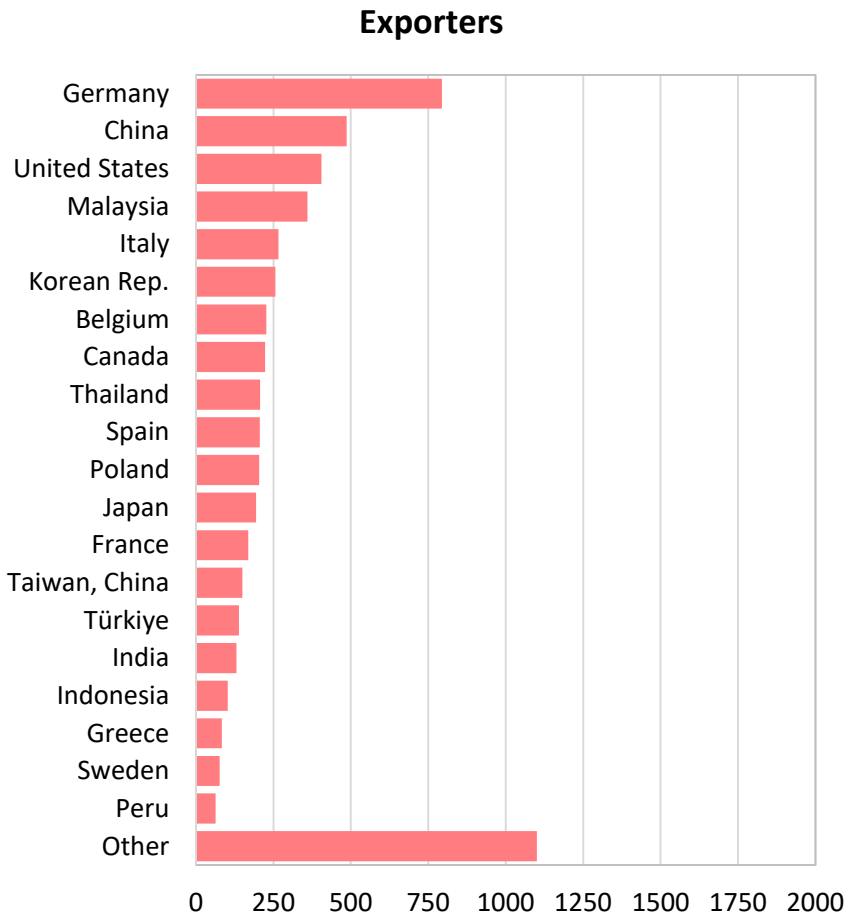


1/ Detailed trade matrices are available in ICSG Statistical Yearbook.

Leading Exporters and Importers of Semi-Fabricated Copper Products, 2023

Thousand metric tonnes gross weight, Source: ICSG





CHAPTER 6: COMMODITY COPPER: EXCHANGES, PRICES AND STOCKS

Copper, as any other good or merchandise, is traded between producers and consumers. Producers sell their present or future production to clients, who transform the metal into shapes or alloys so that downstream fabricators can transform these into different end-use products. One of the most important factors in trading a commodity such as copper is the settlement price for the present day (spot price) or future days.

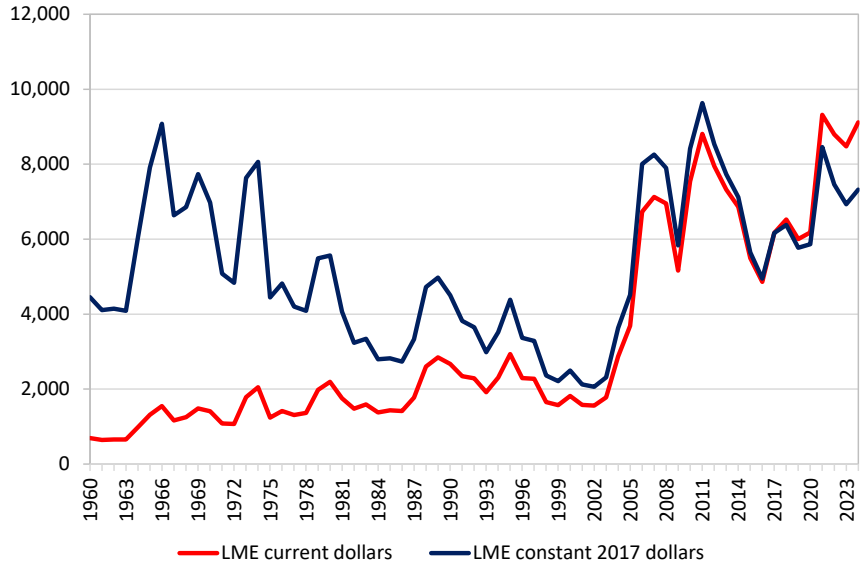
Exchanges

The role of a commodity exchange is to facilitate and make transparent the process of settling prices. Three commodity exchanges provide the facilities to trade copper: The London Metal Exchange (LME), the Commodity Exchange Division of the New York Mercantile Exchange (COMEX/NYMEX), and the Shanghai Futures Exchange (SHFE). In these exchanges, prices are settled by bid and offer, reflecting the market's perception of the supply and demand of a commodity on a particular day. On the LME, copper is traded in 25-tonne lots and quoted in US dollars per tonne; on COMEX, copper is traded in lots of 25,000 pounds and quoted in US cents per pound; and on the SHFE, copper is traded in lots of 5 tonnes and quoted in Renminbi per tonne. More recently, mini contracts of smaller lot sizes have been introduced at the exchanges.

Exchanges also provide for the trading of futures and options contracts. These allow producers and consumers to fix a price in the future, thus providing a hedge against price variations. In this process, the participation of speculators, who are ready to buy the risk of price variation in exchange for monetary reward, gives liquidity to the market. A futures or options contract defines the quality of the product, the size of the lot, delivery dates, delivery warehouses, and other aspects related to the trading process. Contracts are unique for each exchange. The existence of futures contracts also enables producers and their clients to agree on different price-settling schemes to accommodate various interests.

Exchanges also provide warehousing facilities that enable market participants to make or take physical delivery of copper in accordance with each exchange's criteria.

Average Annual Copper Prices (LME Settlement), 1960-2024*
US$ per tonne
Source: ICSG

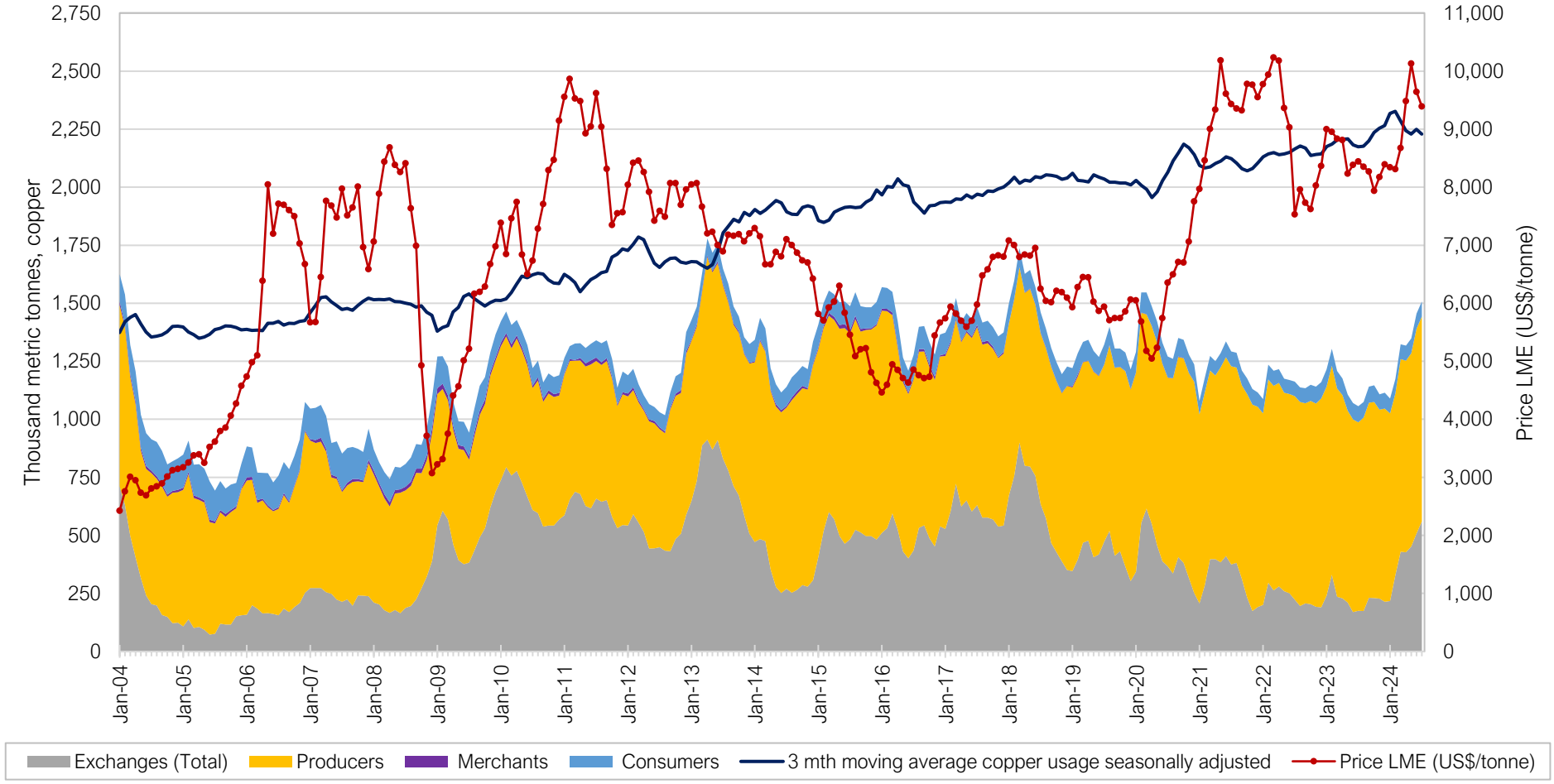


** Note: 2024 Jan-Jul*

COPPER STOCKS, PRICES, AND USAGE (JAN 2004 – JUL 2024)

Thousand metric tonnes of copper and US$/tonne

Source: ICSG



All areas represent month-end copper stocks (left axis). Prices are averages for the period.

CHAPTER 7: COPPER USAGE

HOW IS COPPER USED?

Copper is primarily shipped to fabricators in the form of cathode, wire rod, billet, cake (slab), or ingot. These materials are then processed through various methods such as extrusion, drawing, rolling, forging, melting, electrolysis, or atomization to create wire, rod, tube, sheet, plate, strip, castings, powder, and other shapes. The fabricators that produce these shapes are known as the first users of copper. The total use of copper includes copper scrap that is directly melted by the first users of copper to produce copper semis.

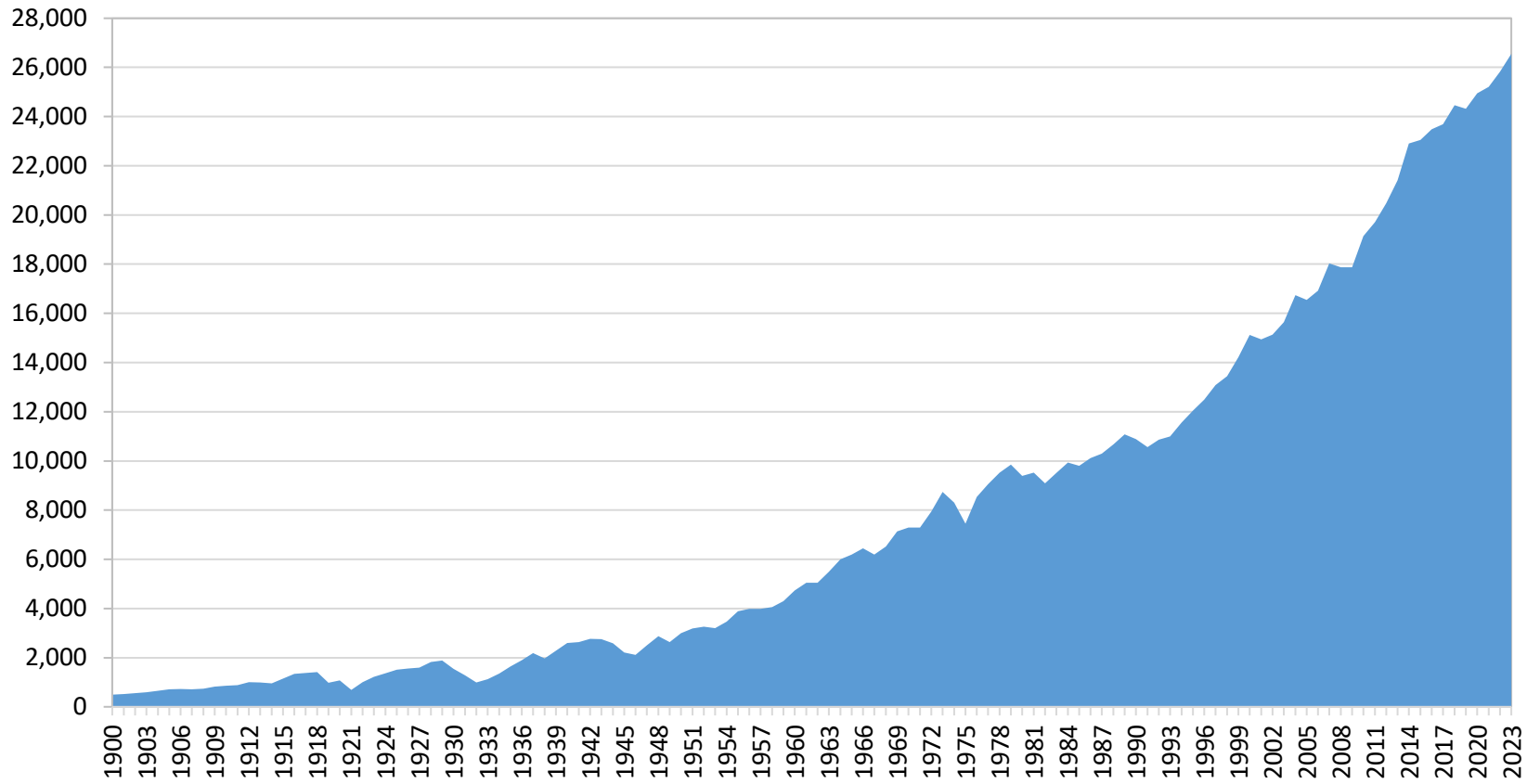
Copper and copper alloy semis can be further transformed by downstream industries for use in end-use products such as automobiles, appliances, electronics, and a whole range of other copper-dependent products to meet society's needs. This section provides a range of information about refined copper usage, total use, major uses of copper, and end-use.

For the most up-to-date information on refined copper usage, please visit the ICSG website at www.icsg.org

World Refined Copper Usage, 1900-2023

Thousand metric tonnes of copper

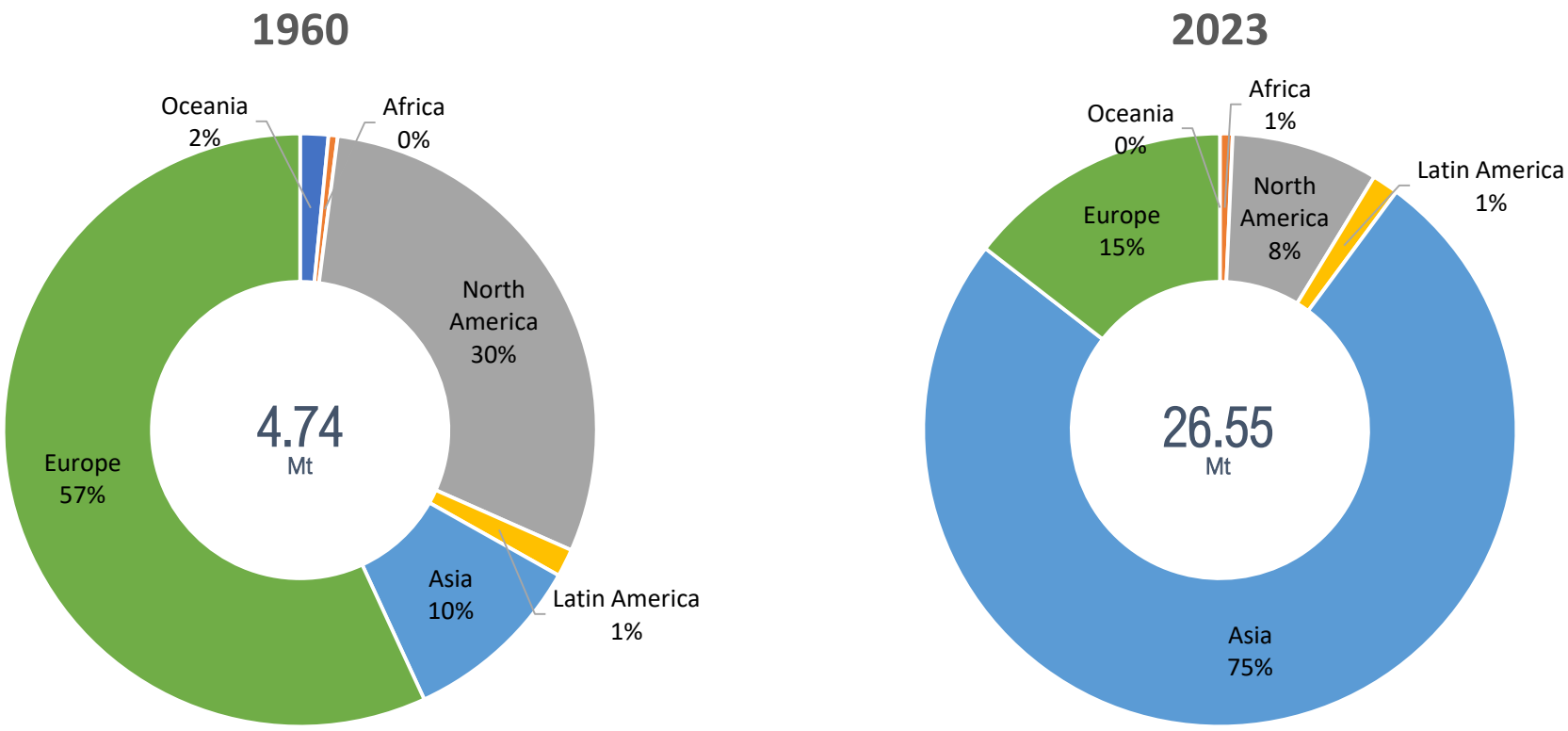
Source: ICSG



Since 1900, apparent usage for refined copper has increased from less than 500 thousand tonnes to 26.5 million metric tonnes in 2023 as usage over the period grew by a compound annual growth rate of 3.3% per year.

SHARE OF REFINED COPPER USAGE BY REGION, 1960 VERSUS 2023

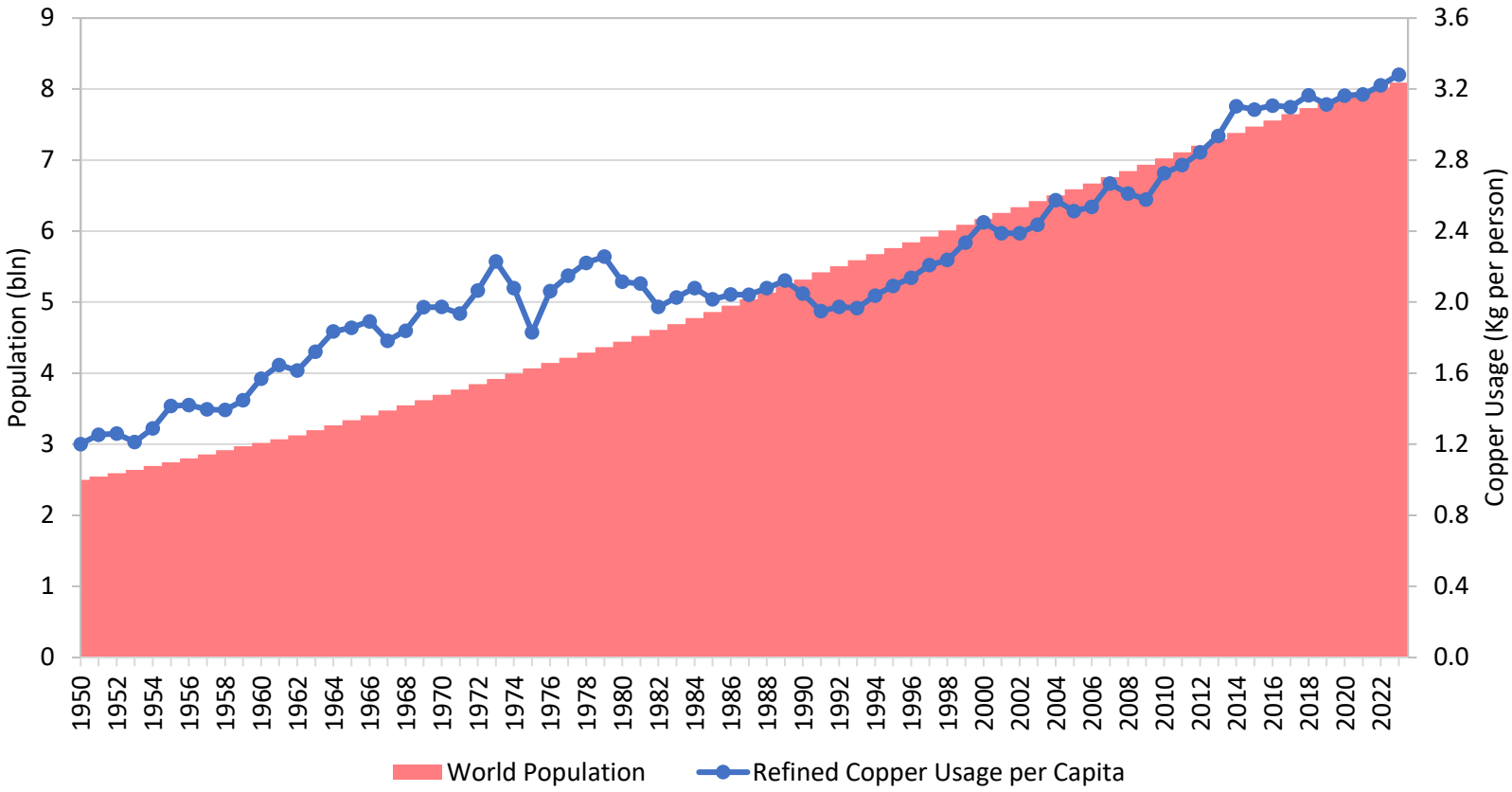
Source: ICSG



Asia's share of refined copper usage has increased dramatically from just 10% in 1960 to a commanding 75% in 2023. This reflects the region's rapid industrial growth and its emergence as the primary driver of global copper demand, which has expanded eightfold over the past four decades, largely because of China.

World Refined Copper Usage per Capita, 1950-2023*

Sources: ICSG and United Nations

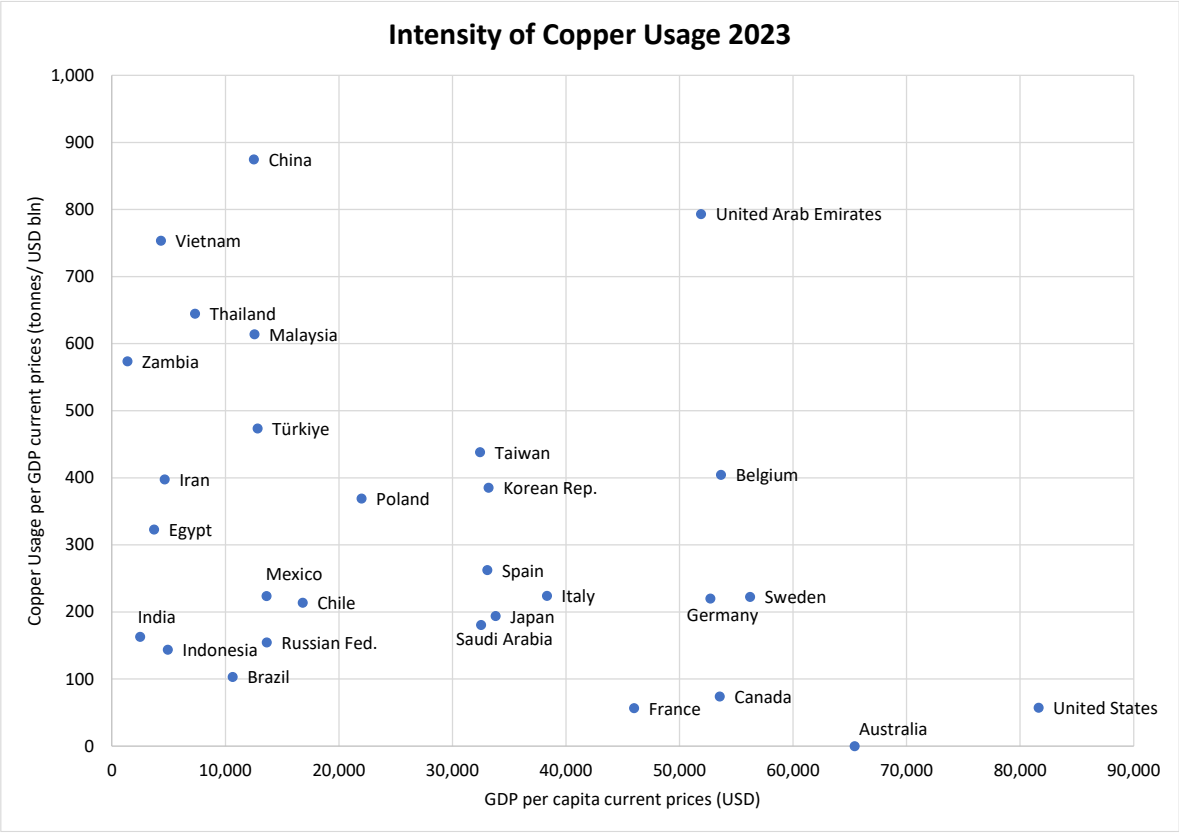


*Refined copper is typically used by semis fabricators or the "first users" of refined copper, including ingot makers, master alloy plants, wire rod plants, brass mills, alloy wire mills, foundries and foil mills. As a result, **per capita usage of refined copper refers to the amount of copper used by the semis industry divided by the total population** and does not represent copper used in finished products per person.

INTENSITY OF REFINED COPPER USAGE *

Sources: ICSG and International Monetary Fund

2023 data	GPD per capita (USD)	Intensity (tonnes/USD bln)
Australia	65,434	0
Belgium	53,659	405
Brazil	10,642	103
Canada	53,548	74
Chile	16,816	214
China	12,514	875
Egypt	3,728	323
France	46,001	57
Germany	52,727	220
India	2,500	163
Indonesia	4,942	144
Iran	4,663	398
Italy	38,326	224
Japan	33,806	194
Korean Rep.	33,192	385
Malaysia	12,570	614
Mexico	13,642	224
Poland	21,996	369
Russian Fed.	13,648	155
Saudi Arabia	32,530	181
Spain	33,071	262
Sweden	56,225	223
Taiwan	32,444	438
Thailand	7,337	645
Türkiye	12,849	474
United Arab Emirates	51,909	793
United States	81,632	57
Vietnam	4,324	754
Zambia	1,381	574

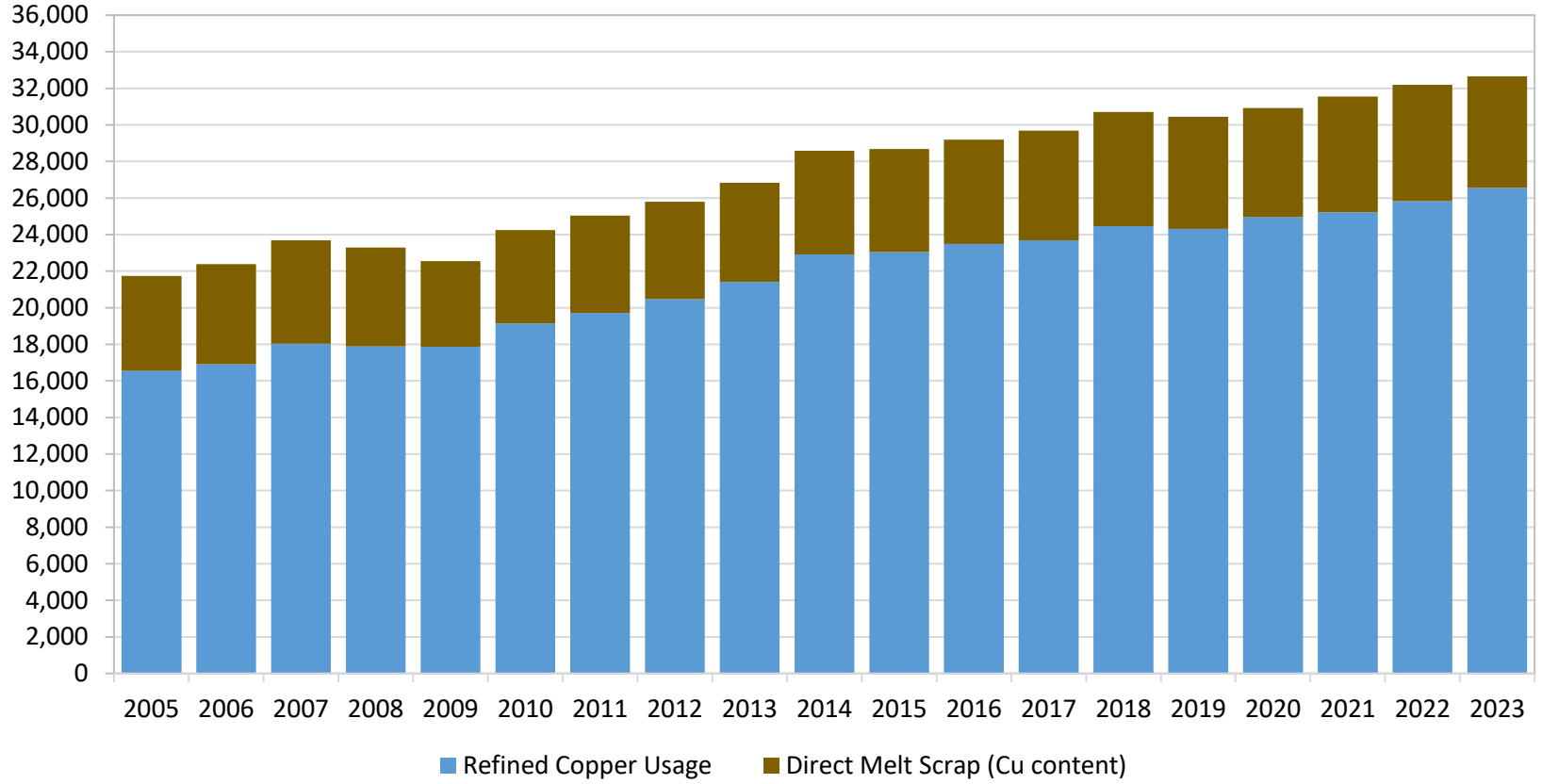


*Refined copper is typically used by semis fabricators or the "first users" of refined copper, including ingot makers, master alloy plants, wire rod plants, brass mills, alloy wire mills, foundries and foil mills. As a result, **intensity of refined copper usage per GDP refers to the amount of copper used by the semis industry divided by GDP** and does not represent copper used in finished products per person.

TOTAL COPPER USAGE, INCLUDING DIRECT MELTED COPPER SCRAP, 2005-2023

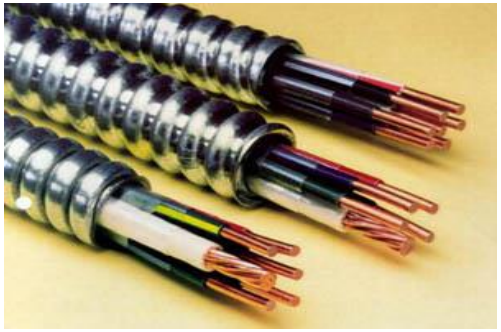
Thousand metric tonnes of copper

Source: ICSG Recyclables Survey June 2024



Direct-melt copper scrap figures for 2023 are preliminary estimates.

MAJOR USES OF COPPER: ELECTRICAL



Copper is the **best non-precious metal conductor** of electricity as it encounters much less resistance compared with other commonly used metals. It sets the standard to which other conductors are compared.

Copper is also used in power cables, either insulated or uninsulated, for high, medium, and low-voltage applications.

In addition, copper's exceptional strength, ductility, and resistance to creeping and corrosion make it the preferred and safest conductor for commercial and residential building wiring.

Copper is an essential component of **energy-efficient** generators, motors, transformers, and renewable energy production systems. **Renewable energy** sources such as solar, wind, geothermal, fuel cells, and other technologies are all heavily reliant on copper due to its excellent conductivity.

ICSG, in partnership with the Common Fund for Commodities, the International Copper Association, and the International Copper Promotion Council (India), undertook the Transfer of Technology for High-Pressure Copper Die Casting in India project. The project facilitated the transfer of technology related to the manufacture of rotors, motors, and motor systems using more energy-efficient high-pressure copper die castings.

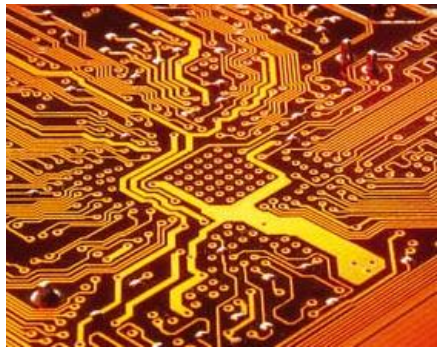
Images courtesy of the Copper Development Association.

Major Uses of Copper: Electronics and Communications

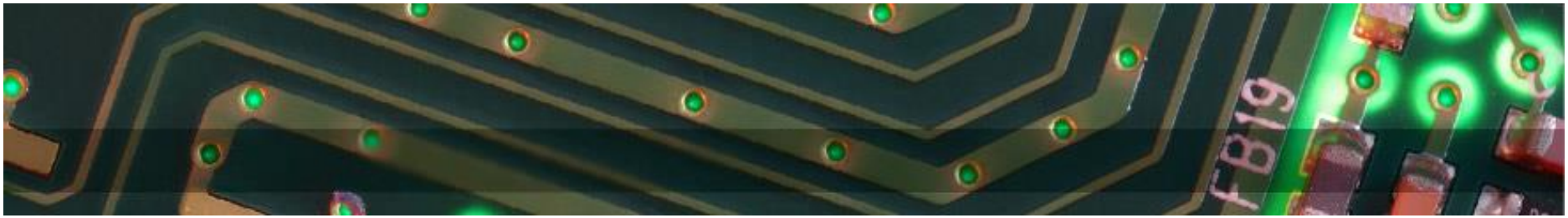
Copper plays a key role in worldwide information and communications technologies. HDSL (High Digital Subscriber Line) and ADSL (Asymmetrical Digital Subscriber Line) technology allow for high-speed data transmission, including internet service, through the existing copper infrastructure of ordinary telephone wire.

Copper and copper alloy products are used in domestic subscriber lines, wide and local area networks, mobile phones, and personal computers.

Semiconductor manufacturers have launched a revolutionary "copper chip." By using copper for circuitry in silicon chips, microprocessors are able to operate at higher speeds, using less energy. Copper heat sinks help remove heat from transistors and keep computer processors operating at peak efficiency. Copper is also used extensively in other electronic equipment in the form of wires, transformers, connectors, and switches.



Images courtesy of the Copper Development Association and European Copper Institute.



Major Uses of Copper: Construction

Copper and brass are the materials of choice for plumbing, taps, valves, and fittings. Thanks in part to its aesthetic appeal, copper and its alloys, such as architectural bronze, are used in a variety of settings to build facades, canopies, doors, and window frames.

Unlike plastic tubing, copper does not burn, melt, or release noxious or toxic fumes in the event of a fire. Copper tubes also help protect water systems from potentially lethal bacteria such as legionella. Copper fire sprinkler systems are a valuable safety feature in buildings.

Copper roofing, in addition to being attractive, is well known for its resistance to extreme weather conditions. Major public buildings, commercial buildings, and homes use copper for their rainwater goods and roofing needs. The telltale green patina finish, that gives copper the classic look of warmth and richness, is the result of natural weathering.

Images courtesy of the Copper Development Association and the International Copper Association.

The use of copper doorknobs and plates exploits copper's **biostatic properties** to help prevent the transfer of disease and microbes.

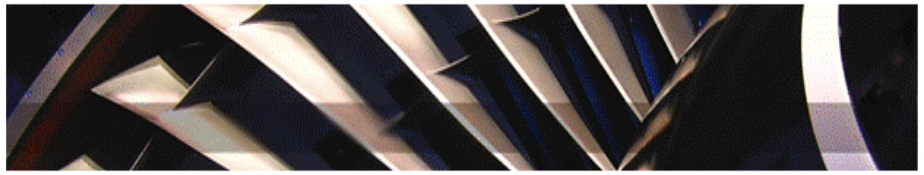
Major Uses of Copper: Industrial Machinery and Equipment

Wherever industrial machinery and equipment are found, it is a safe bet that copper and its alloys are present. Due to **their durability, machinability,** and **ability to be cast with high precision** and tolerances, copper alloys are ideal for making products such as gears, bearings, and turbine blades.

Copper's superior heat transfer capabilities and ability to withstand extreme environments make it an ideal choice for heat exchange equipment, pressure vessels, and vats.

The **corrosion-resistant properties** of copper and copper alloys (such as brass, bronze, and copper-nickel) make them especially suitable for use in marine and other demanding environments.

Vessels, tanks, and piping exposed to seawater, propellers, oil platforms, and coastal power stations, all depend on copper's corrosion resistance for protection.



Images courtesy of the Copper Development Association.

Major Uses of Copper: Consumer and General Products

From the beginning of civilization, copper has been used by various societies to make **coins** for currency.

Today, countries are replacing lower denomination bills with copper-based coins, as these coins last 10, 20, and even 50 times longer.

In the United States, one-cent coins and five-cent coins contain 2.5% and 75% copper, respectively, while other U.S. coins contain a pure copper core and 75% copper face [1]. In the European Union, the Euro coins, first introduced in 2002, also contain copper.

Copper and copper-based products are used in offices, households, and workplaces. **Computers, electrical appliances, cookware, brassware**, and **locks** and **keys** are just some of the products exploiting copper's advantages.

In addition, in areas known to be copper deficient, copper is used by farmers to supplement livestock and crop feed.

Images courtesy of the International Copper Association and the Copper Development Association.

1/ Source: U.S. Department of the Treasury.

MAJOR USES OF COPPER: TRANSPORTATION

All major forms of transportation depend on copper to perform critical functions.

Copper-nickel alloys are used on the hulls of boats and ships to **reduce marine befouling**, thereby reducing drag and improving fuel consumption.

Automobiles and trucks rely on copper motors, wiring, radiators, connectors, brakes, and bearings. Today, the average internal combustion engine contains about 22.5 kg (50 lbs.) of copper, while luxury cars on average contain around 1,500 copper wires totaling about 1.6 km (1 mile) in length.

Images courtesy of the Copper Development Association and the European Copper Institute.

ELECTRIC VEHICLES

Electric vehicles (EVs) contain approximately four times more copper than conventional cars. It is used in batteries, windings, and copper rotors used in electric motors, wiring, busbars, and charging infrastructure.

Copper Use in EVs

- Conventional cars 23kg
- Hybrid electric vehicles (HEV) 40 kg
- Plug-in hybrid electric vehicles (PHEV) 60 kg
- Battery electric vehicles (BEVs) 83 kg
- Hybrid electric bus (Ebus HEV) 89 kg
- Battery-powered electric bus (Ebus BEV) 224-369 kg (depending on the size of battery)

Source: ICA

Almost 14 million new electric cars were registered globally in 2023, bringing their total number on the roads to 40 million. Electric car sales in 2023 were 3.5 million higher than in 2022, a 35% year-on-year increase. This is more than six times higher than in 2018, just 5 years earlier. In an effort to reduce carbon emissions, the use of EVs will continue to rise. The demand for EVs is also expected to increase as a result of technology

improvements, increased affordability, and the deployment of more electric chargers (each EV charger will add 0.7 kg of copper. Fast chargers can add up to 8 kg of copper each). This increase will result in greater demand for copper.

Copper's superior thermal conductivity, strength, corrosion resistance, and recyclability also make it ideal for automotive and truck radiators. New manufacturing technologies, processes, and innovative designs are resulting in lighter, smaller, and more efficient radiators.

Copper is used extensively in **new-generation airplanes and trains**. New high-speed trains can use anywhere from 2 to 4 tonnes of copper, significantly higher than the 1 to 2 tonnes used in traditional electric trains.

Images courtesy of the Copper Development Association and the European Copper Institute.

GROWTH MARKETS FOR COPPER USAGE

In the longer term, copper could benefit from use in the following markets: [1]

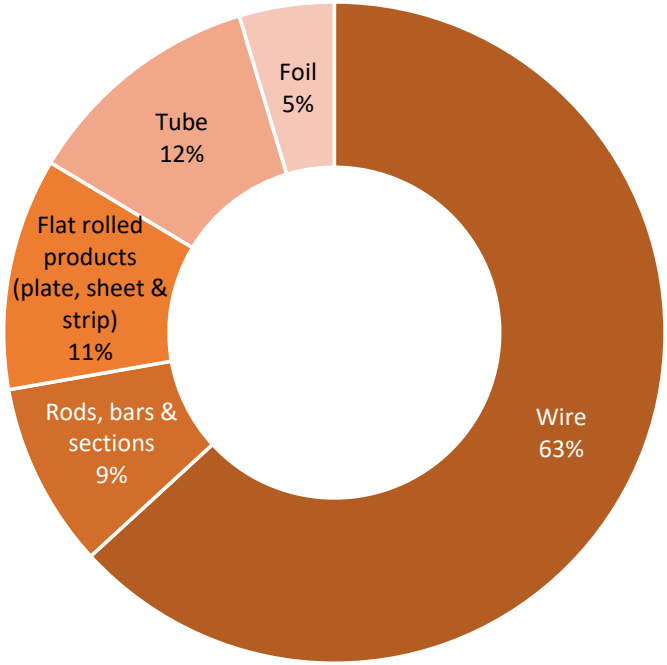
1. **Antimicrobial** – copper is gaining popularity as an alternative to plastic in medical applications, such as sterile table tops and medical cart handles
2. **Aquaculture** – marine aquaculture nets and pens made with copper-alloy mesh are emerging as an effective solution to important problems facing the near-shore fish farming industry
3. **Electrical Propulsion** – powering EVs requires changes to the electrical infrastructure that will benefit from copper
4. **Renewable Energy** – copper plays an important role in clean energy systems from wind to solar thermal plants
5. **Seismic Energy Dissipation** – earthquake damage can be controlled through the use of copper-based devices that absorb energy to limit building motions
6. **Ultra-conductive Copper Components** – progress is being made in the methods of incorporating nanocarbon materials into copper in a way that promises to deliver large efficiency improvements in electrical energy transmission and distribution networks
7. **Electrical Vehicles (EVs)** – to reduce carbon emissions. The rising number of EVs is expected to result in increased copper usage

Source:
1/ ICA Annual Reports.

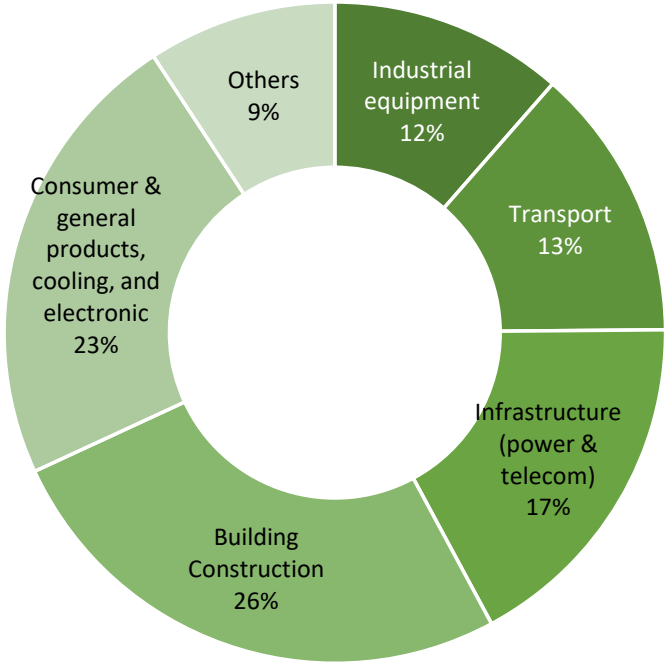
GLOBAL FIRST USE AND END USE OF COPPER, 2023

Source: International Wrought Copper Council (IWCC)

First Use (Semis Production*)



End Use



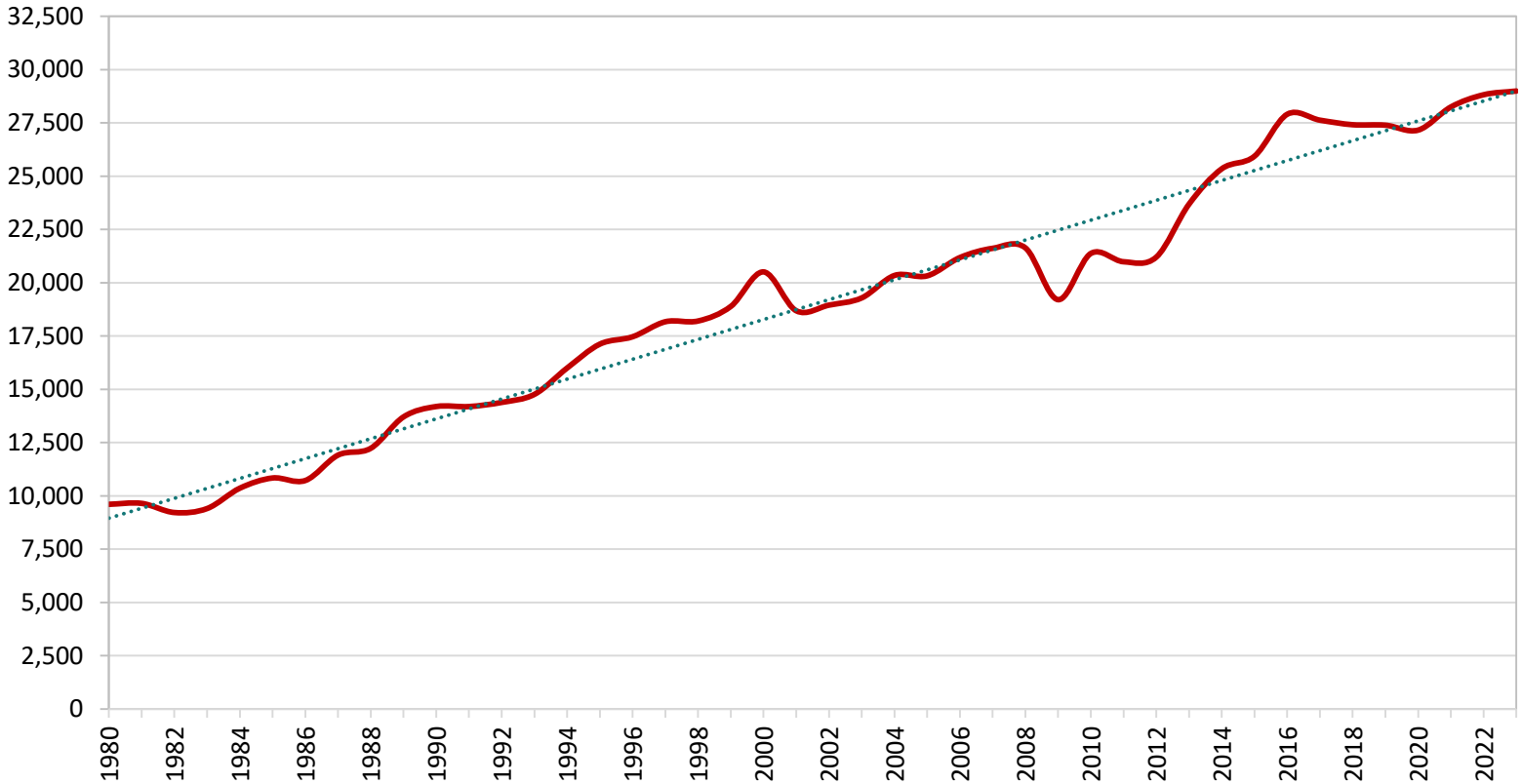
** copper and copper alloy production.*

Notes:
Copper foil production includes foil produced by the rolling process and by electro-deposition.
The copper content of alloy semis is assumed to be 70%.

COPPER & COPPER-ALLOY SEMIS: PRODUCTION, 1980-2023 P

Thousand metric tonnes gross weight

Source: ICSG

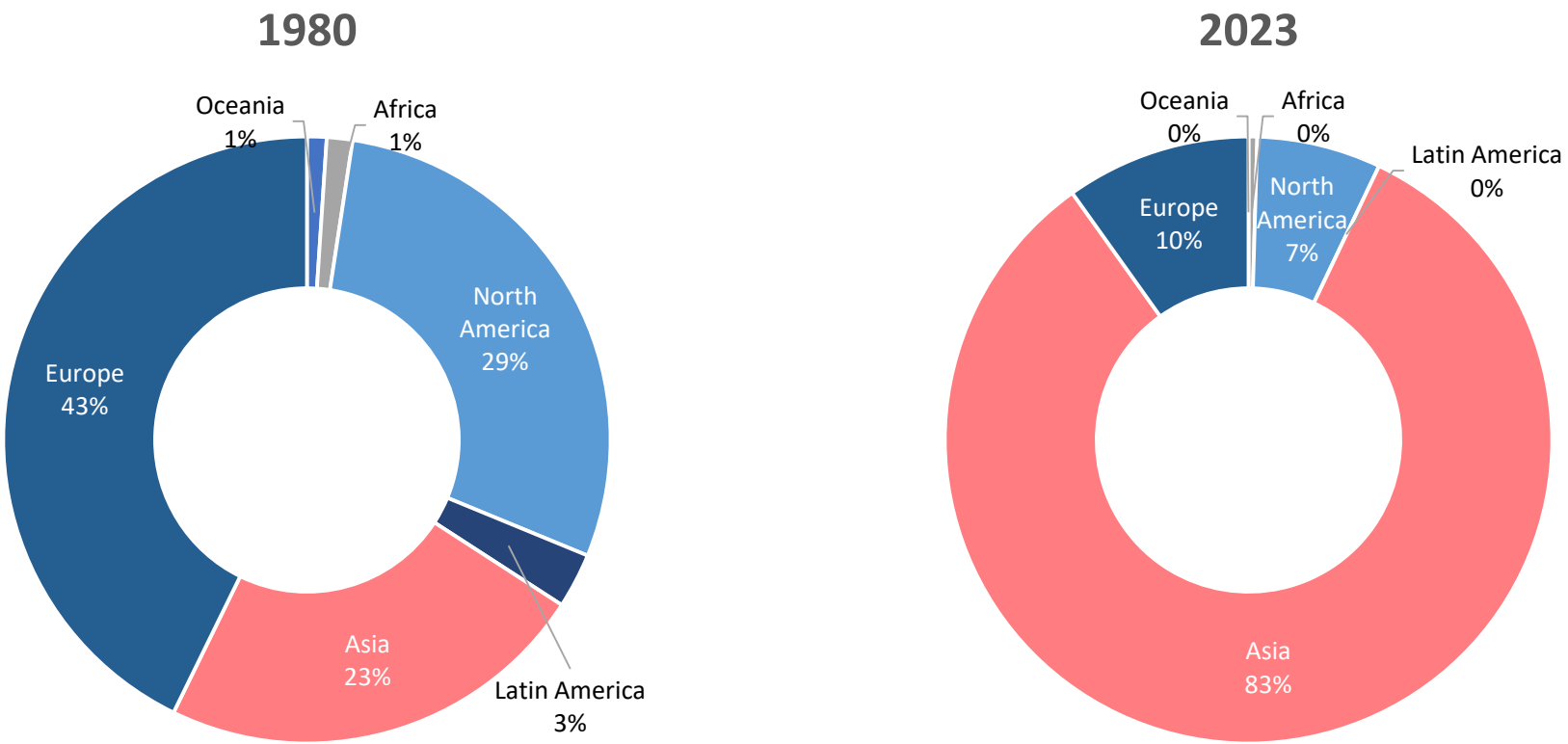


Semis fabricators process refinery shapes such as cathodes, wire bars, ingots, billet slabs, and cake into semi-finished copper and copper alloy products using both unwrought copper materials and direct melt scrap as raw material feed. Semis fabricators are considered to be the "first users" of refined copper and include wire rod plants and brass mills.

P/ Preliminary. Data for some countries still incomplete

COPPER & COPPER-ALLOY SEMIS: PRODUCTION SHARE BY REGION, 1980 VERSUS 2023 P

Source: ICSG



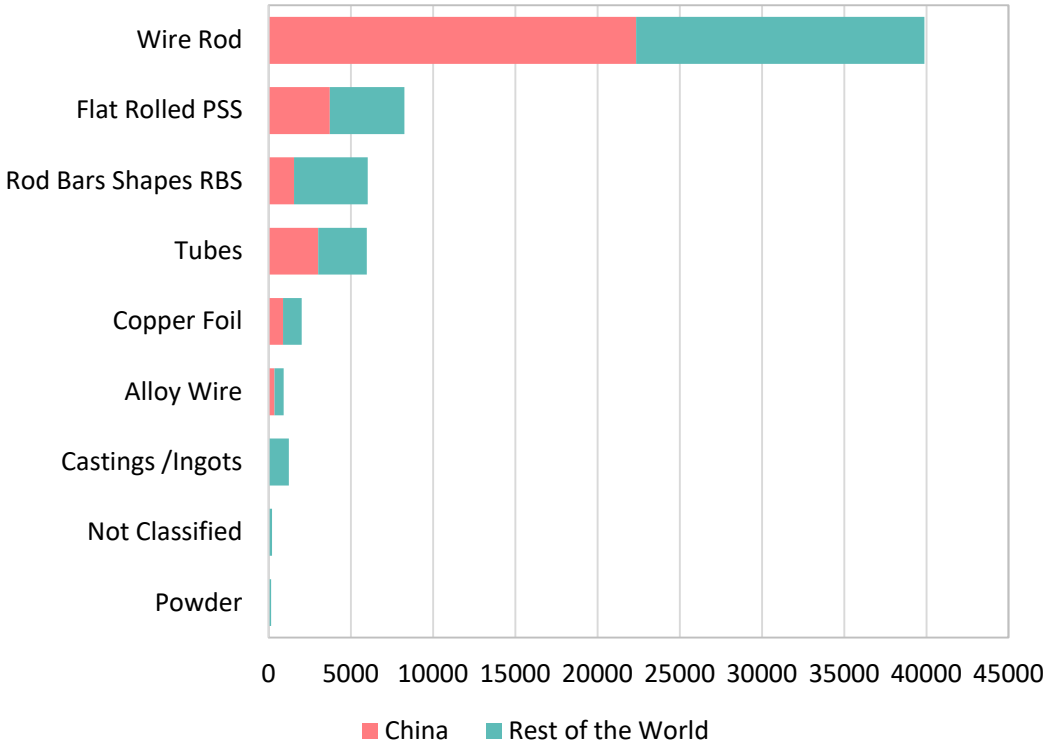
Asia's share of copper and copper-alloy semis production surged dramatically, rising from 23% in 1980 to a commanding 83% in 2023, indicating the region's growing dominance in industrial production, thanks to China. Meanwhile, Europe's production plummeted from 43% to 10%, and North America's share fell from 29% to 7%, reflecting a broader industrial shift towards Asia. Production in Latin America, Africa, and Oceania, which already had small shares in 1980, has become negligible in 2023.

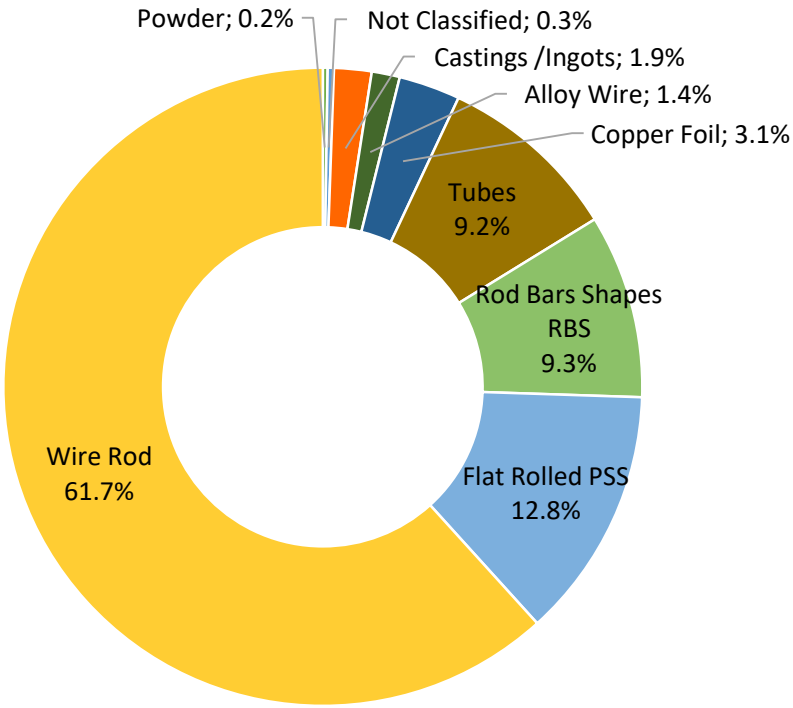
P/ Preliminary. Data for some countries still incomplete

COPPER & COPPER-ALLOY SEMIS: PRODUCTION CAPACITY BY REGION & PRODUCT, 2023 P

Thousand metric tonnes gross weight

Source: Preliminary results of the 2024 ICSG Directory of Copper & Copper Alloy Fabricators



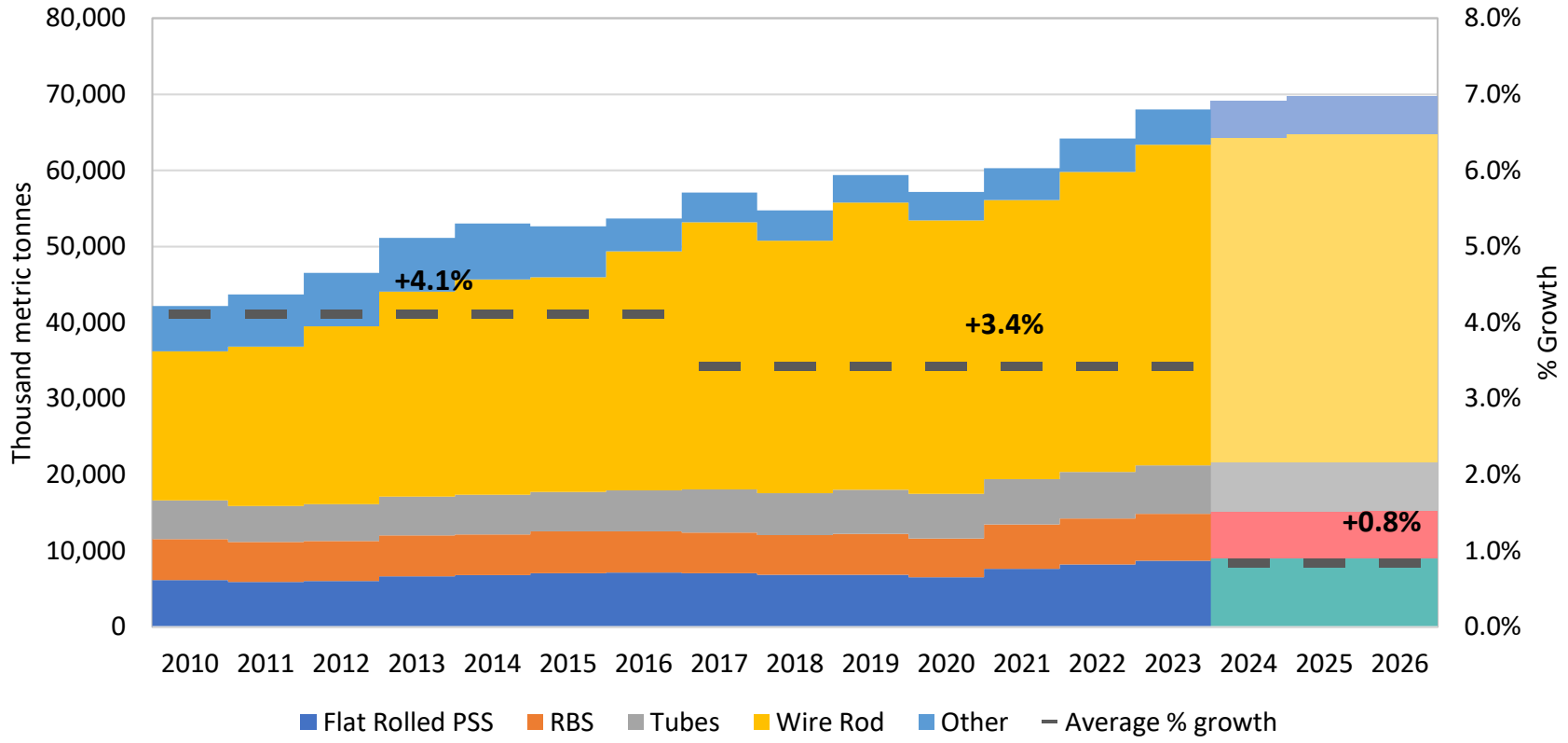


Note: Capacity data reflects production capabilities not necessarily production forecasts.

P/ Preliminary.

COPPER & COPPER-ALLOY SEMIS: TRENDS IN PRODUCTION CAPACITY, 2010-2026

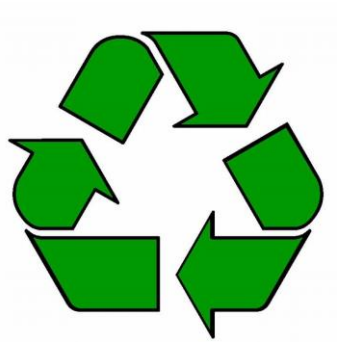
Thousand metric tonnes gross wight (bars) and Annual percentage change (dashed line)
Source: Preliminary results of the 2024 ICSG Directory of Copper & Copper Alloy Fabricators [1/]



The production capacity of copper and copper-alloy semis is anticipated to reach nearly 70 million tonnes by 2026. Since 2017, it has grown at a rate of 3.4%. Looking ahead, growth is expected to continue, but at a slower rate of 0.8% through 2026.

Note: Capacity data reflects production capabilities not necessarily production forecasts.
1/ Available for sale - See our Publications Order Form on Page 61.

CHAPTER 8: COPPER RECYCLING



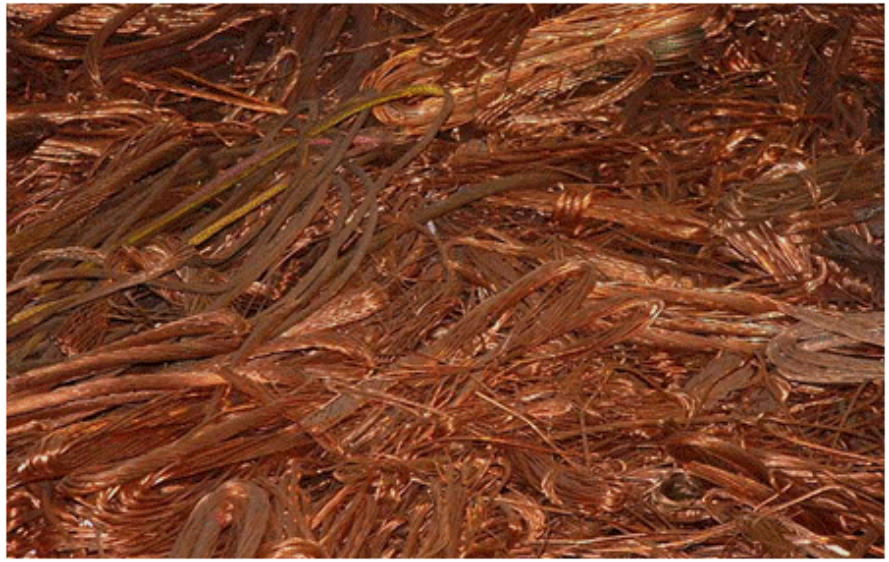
Copper is among the few materials that do not degrade or lose their chemical or physical properties in the recycling process. Considering this, the existing copper reservoir in use can well be considered a legitimate part of world copper reserves. In recent decades, an increasing emphasis has been placed on the sustainability of material uses in which the concept of reuse and recycling of metals plays an important role in the material choice and acceptance of products. If appropriately managed, recycling has the potential to extend the use of resources and minimize energy use, some emissions, and waste disposal.

Closing metal loops through increased reuse and recycling enhances the overall resource productivity and therefore represents one of the key elements of society's transition towards more sustainable production and consumption patterns. It is widely recognized that recycling is not in opposition to primary metal production but is a necessary and beneficial complement.

In 2023, ICSG estimates that 32% of global copper use came from recycled copper. Some countries' copper requirements greatly depend on recycled copper to meet internal demands. However, recycled copper alone cannot meet society's needs, so we also rely on copper produced from the processing of mineral ores.

Images courtesy of the European Copper Institute.

Copper Recycling Rate Definitions



The recycling performance of copper-bearing products can be measured and demonstrated in various ways – depending, among other things, on objectives, scope, data availability, and target audience. The three International Non-Ferrous Metal Study Groups in conjunction with various metal industry associations agreed on the common definitions of the three following metal recycling rates:

- The **Recycling Input Rate** (RIR) measures the proportion of metal and metal products that are produced from scrap and other metal-bearing low-grade residues. The RIR is mainly a statistical measurement of raw material availability and supply rather than an indicator of the recycling efficiency of processes or products. The RIR has been in use in the metals industry for a long time and is widely available from statistical sources. Major target audiences for this type of "metallurgical" indicator are the metal industry, metal traders, and resource policymakers. However, given structural and process variables, it may have limited use as a policy tool.

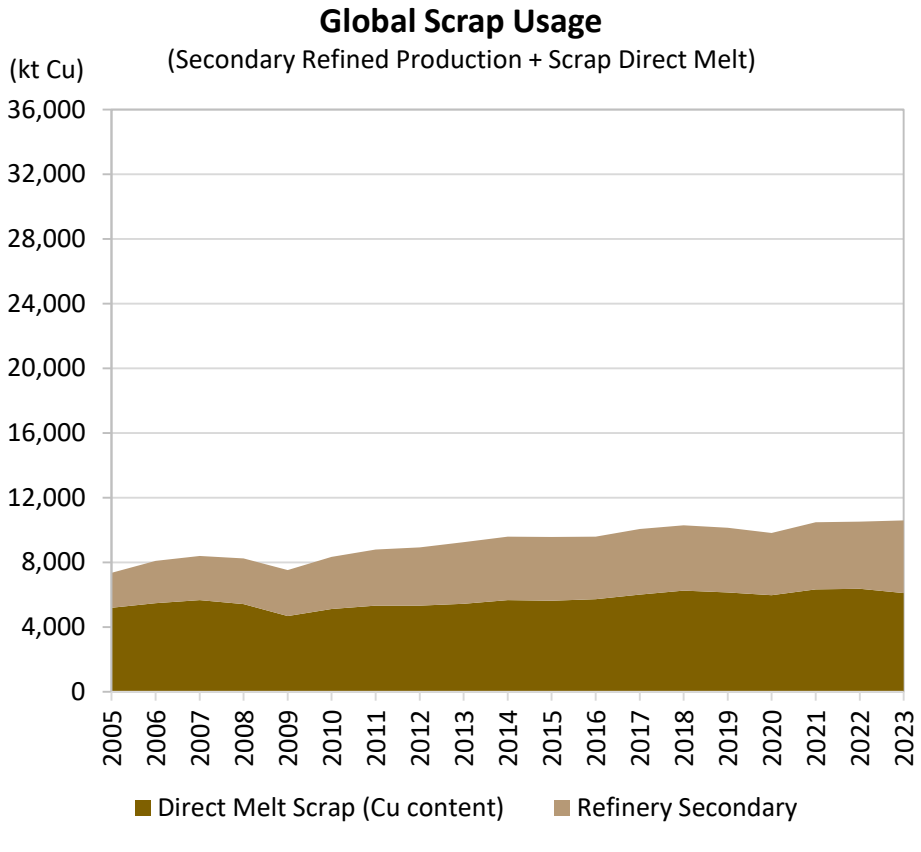
- The **Overall Recycling Efficiency Rate** indicates the efficiency with which end-of-life (EOL) scrap, new scrap, and other metal-bearing residues are collected and recycled by a network of collectors, processors, and metal recyclers. The key target audiences of this particular indicator are the metal industry, scrap processors, and scrap generators.

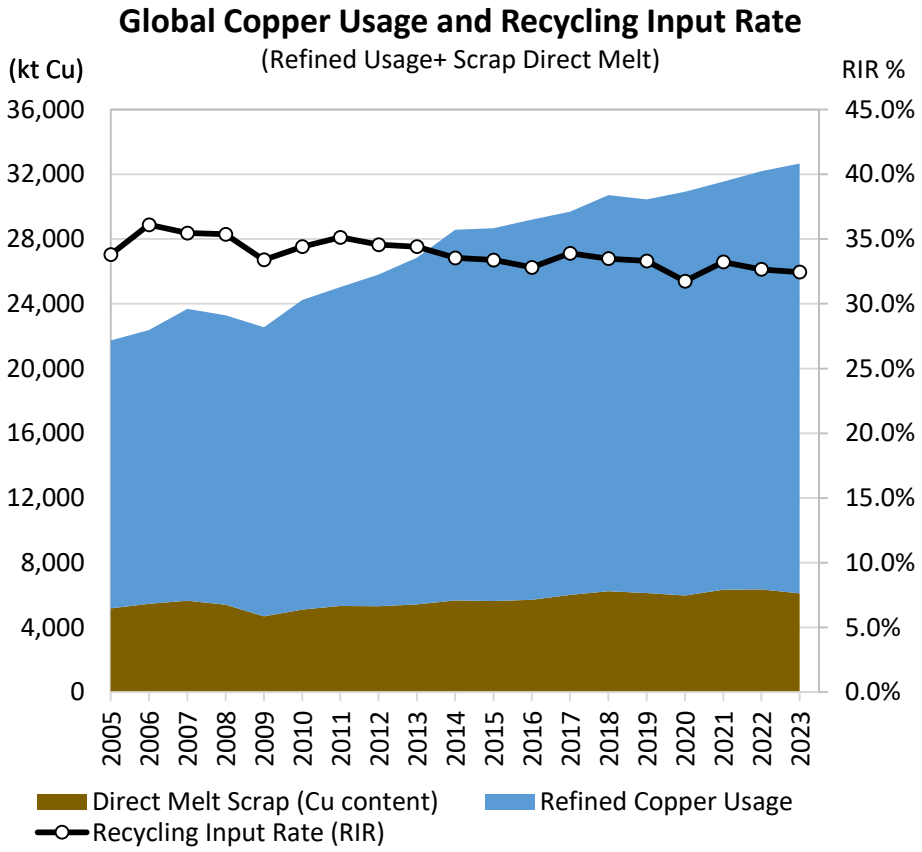
- The **EOL Recycling Rate** indicates the efficiency with which EOL scrap from obsolete products is recycled. This measure focuses on end-of-life management performance of products and provides important information to target audiences such as metal and recycling industries, product designers, life cycle analysts, and environmental policymakers.

ICSG Global Copper Scrap Usage and Recycling Input Rate, 2005-2023

Thousand metric tonnes of copper

Source: ICSG





Direct-melt copper scrap figures for 2023 are preliminary estimates, as is the Recycling Input Rate (RIR).

ICSG Global Copper Scrap Research Project and Recent Scrap Reports

Based on interest expressed by member countries, ICSG launched the copper scrap market project in 2007 in order to provide greater transparency on an increasingly vital component of the world copper market at a time when globalization is reshaping the copper scrap and copper alloy recycling business. The final report of the project was published in August 2010.

Since then, ICSG has completed a number of detailed new reports on scrap recovery and supply in NAFTA, Europe, the Middle East, Asia, and China.

Recycling has become an essential and crucial part of the copper industry not only as a complement to primary supply but as an important contributor to a sustainable circular economy and as a means to meet increased future demand for copper.

Over the last few years, interest in expanding the capacity of existing secondary smelters and refineries has increased. Consequently, a number of new projects have been announced with some already being developed. This increased trend in secondary production capacity will change the scrap market and scrap trade flows and should lead to an increase in the global supply of refined copper.

In 2024, the ICSG started a project aiming at assessing in detail trends in global secondary smelter/refined production, evaluating new secondary smelter/refinery projects, analyzing regulatory issues impacting scrap flows (collection, trade, and use), improving and updating the information contained in the ICSG secondary production and assisting work regarding the estimation of recycling rates.

For more information about ICSG work related to copper scrap, please contact the ICSG Secretariat at mail@icsg.org

Key Drivers of the Global Copper Scrap Market

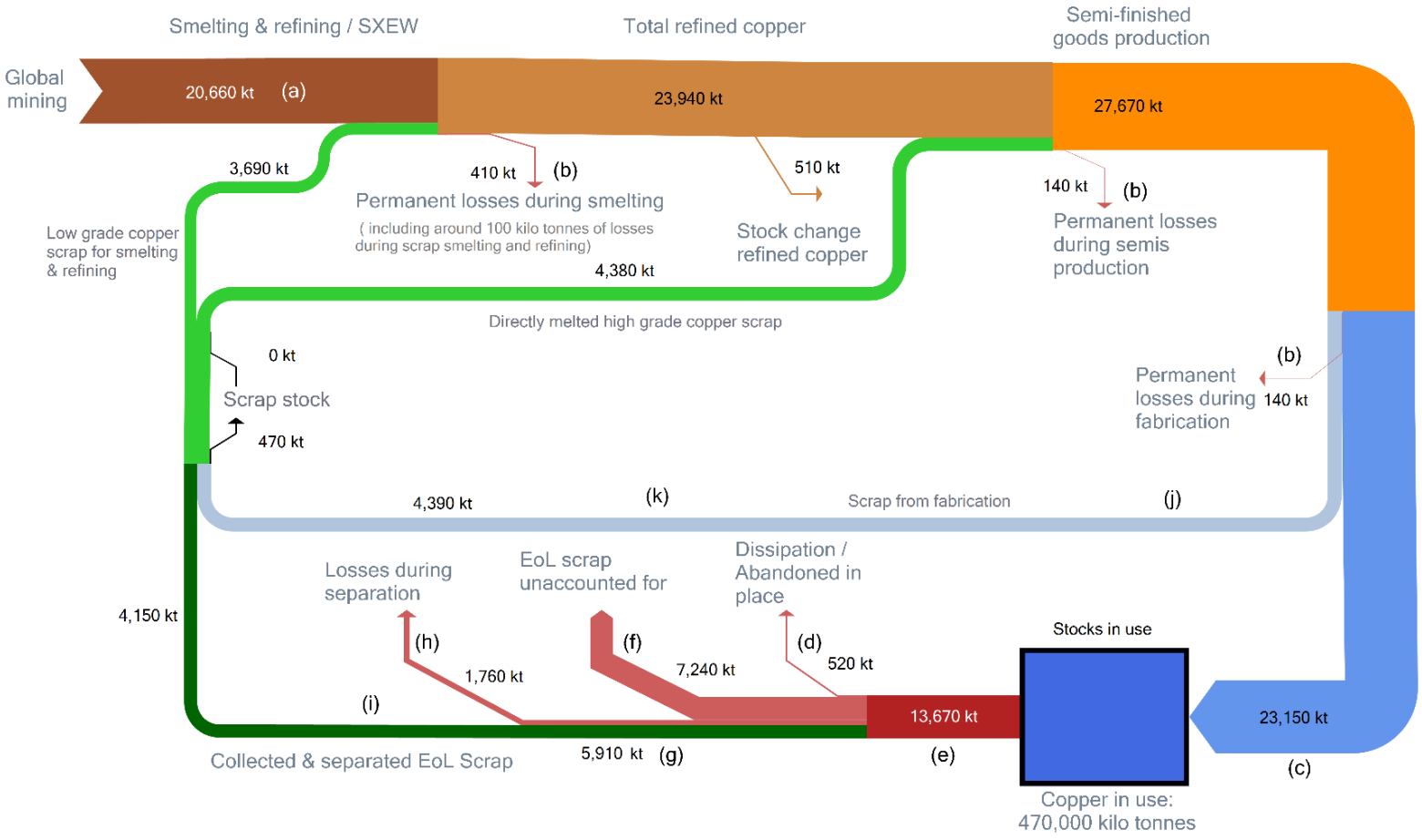
- Expanding Copper Mine Production and Refined Copper Substitution
- Industrialization and Economic Growth
- Prices
    - Copper Scrap Prices and Spreads
    - Refined Copper Prices and the Demand for Scrap
- Chinese scrap market developments
- The Shift in Regional Scrap Processing Capacity
- Regulations on Recycling and Trade
- Technology

ICSG Global Copper Scrap Project Reports

- The Chinese Copper Smelter and Refining Industry (2022).
- North American Semi-Manufactured Copper Products Capacity (2021)
- European Semi Manufactured Copper Products Capacity (2019)
- Copper Use in Fabrication in Japan, Korea, Taiwan (China), and Vietnam (2018)
- Industrial Use of Refined Copper and Scrap in Fabrication in China (2017)
- Manufacture and Use of Semi-fabricated copper in Latin America/Canada (2017)

INDUSTRY GLOBAL FLOWS OF COPPER (2020) AND DERIVED RECYCLING RATES

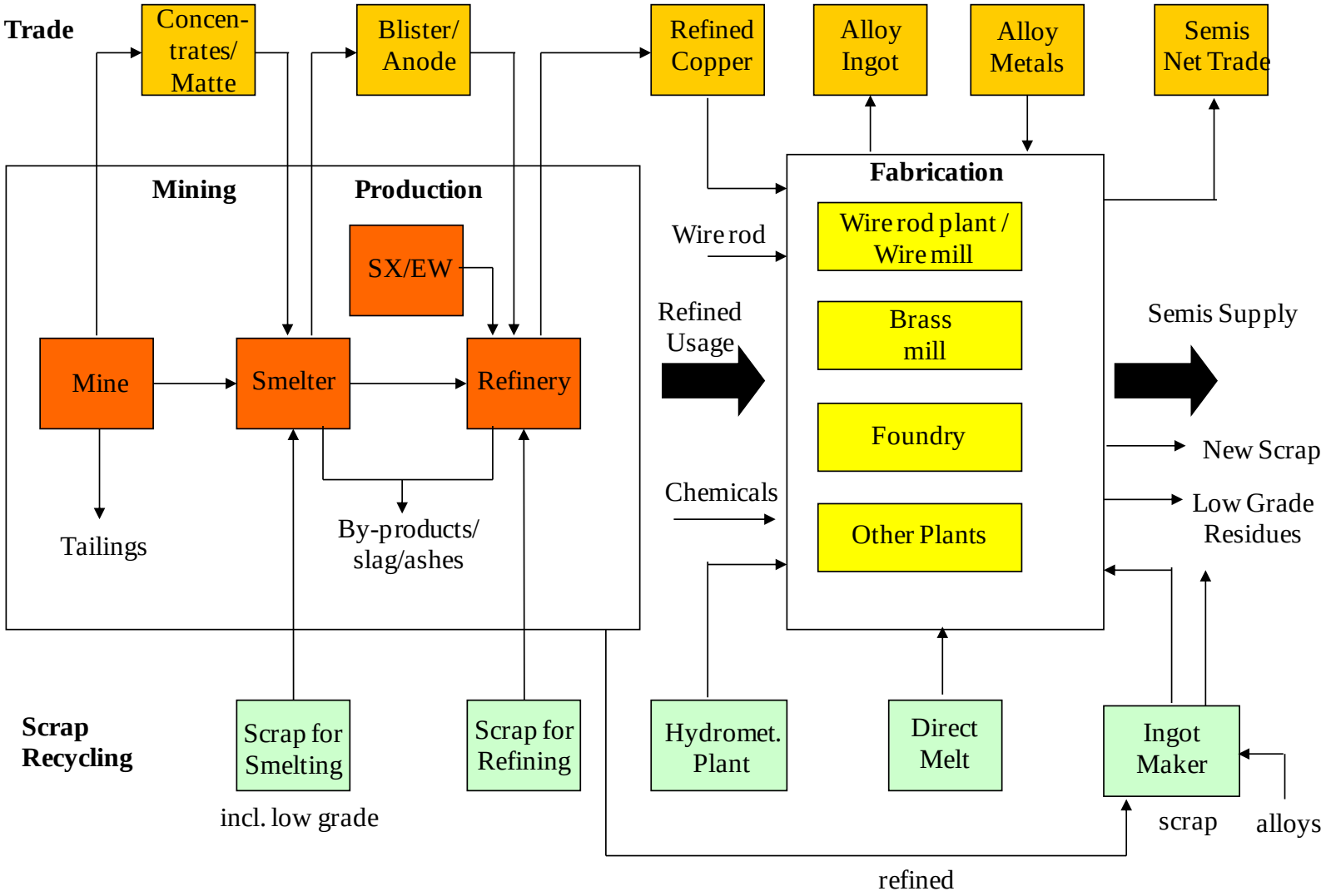
Figures produced for the International Copper Association by Fraunhofer ISI based on Environ. Sci. Technol. 47 (12), pp. 6564–6572 (freely available under http://dx.doi.org/10.1021/es400069b)



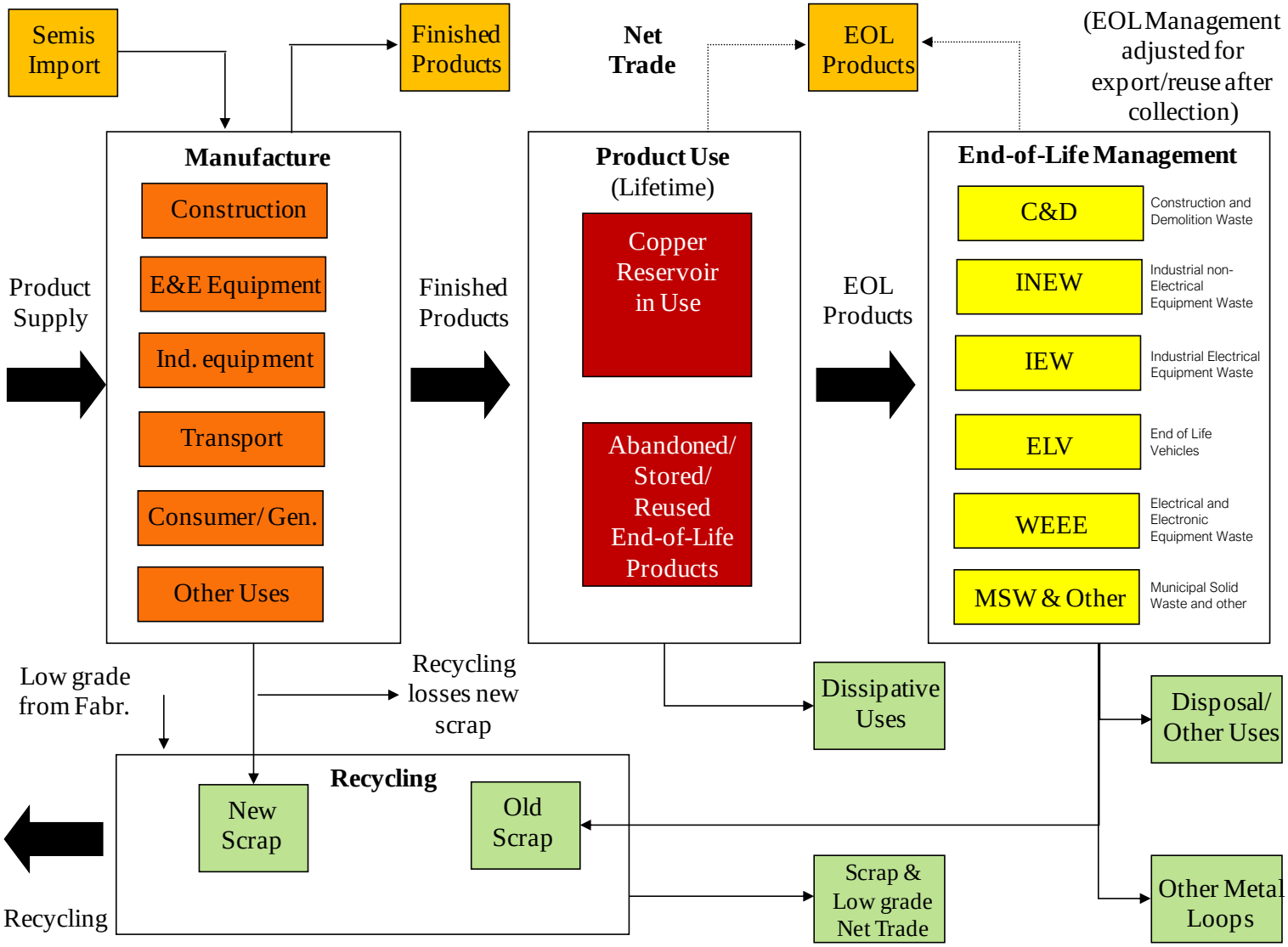
Recycling indicator	10-yr avg
Recycling input rate	31%
EoL recycling input rate	16%
EoL collection rate	55%
EoL processing rate	71%
EoL recycling rate	39%
Overall processing rate	82%
Overall recycling efficiency rate	55%
Old Scrap Ratio	50%

Note: As of 2020, the global flow model and the recycling indicators will be updated periodically by the ICA and Fraunhofer

THE FLOW OF COPPER



THE FLOW OF COPPER (CONT.)



ANNEX

World Copper Production and Refined Copper Usage, 1960-2023

Thousand Metric Tonnes Copper

Source: ICSG

	Mine Production	Refined Production	Refined Usage
1960	3,924	4,998	4,738
1961	4,081	5,127	5,050
1962	4,216	5,296	5,048
1963	4,286	5,400	5,500
1964	4,443	5,739	5,995
1965	4,769	6,059	6,193
1966	4,987	6,324	6,445
1967	4,743	6,004	6,195
1968	5,010	6,653	6,523
1969	5,682	7,212	7,137
1970	5,900	7,592	7,291
1971	5,941	7,404	7,296
1972	6,541	8,100	7,942
1973	6,915	8,544	8,740
1974	7,097	8,759	8,310
1975	6,735	8,187	7,445
1976	7,289	8,632	8,539
1977	7,444	8,884	9,057
1978	7,306	9,030	9,527
1979	7,372	9,200	9,848
1980	7,227	9,261	9,396
1981	7,721	9,573	9,522
1982	7,745	9,319	9,090
1983	7,824	9,541	9,510
1984	8,135	9,440	9,930
1985	8,314	9,616	9,798
1986	8,295	9,920	10,112
1987	8,620	10,148	10,293
1988	8,773	10,512	10,668
1989	9,086	10,908	11,081
1990	9,227	10,805	10,886
1991	9,373	10,686	10,563
1992	9,497	11,042	10,866
1993	9,571	11,274	10,992
1994	9,539	11,118	11,560
1995	10,070	11,817	12,043
1996	11,084	12,628	12,489
1997	11,514	13,425	13,082
1998	12,228	14,032	13,440
1999	12,767	14,576	14,223
2000	13,199	14,793	15,122
2001	13,636	15,638	14,938
2002	13,487	15,354	15,133
2003	13,699	15,272	15,641
2004	14,594	15,918	16,743
2005	14,927	16,572	16,552
2006	14,983	17,288	16,917
2007	15,508	17,895	18,026
2008	15,532	18,191	17,877
2009	15,941	18,234	17,870
2010	15,987	18,981	19,136
2011	15,960	19,601	19,709
2012	16,678	20,194	20,479
2013	18,173	21,058	21,408
2014	18,420	22,490	22,906
2015	19,152	22,838	23,046
2016	20,396	23,356	23,481
2017	20,065	23,553	23,686
2018	20,601	24,105	24,466
2019	20,672	24,162	24,316
2020	20,746	24,656	24,948
2021	21,262	24,936	25,211
2022	21,922	25,306	25,830
2023/p	22,364	26,547	26,549

p/ preliminary

ICSG PUBLICATIONS ORDER FORM

Prices are quoted in Euros. For US dollars payments contact ICSG at mail@icsg.org or
Tel: 351-21-351-3870 Fax: 351-21-352-4035.

PUBLICATION	Member Country*	Non-Member Country	Total
The ICSG monthly publication COPPER BULLETIN ○ One year's subscription (12 issues + Yearbook) ○ Access to **ICSG Online Database for COPPER BULLETIN data** (only available to subscribers of the COPPER BULLETIN)	€600 €200	€1,050 €300	
2023 ICSG STATISTICAL YEARBOOK (single issue)	€250	€500	
The ICSG DIRECTORY OF COPPER MINES, SMELTERS AND REFINERIES ○ One year's subscription (2 issues) ○ Single issue ○ Access to **ICSG Online Database for DIRECTORY data** (only available to subscribers of the DIRECTORY OF COPPER MINES, SMELTERS AND REFINERIES)	€600 €400 €200	€1,050 €800 €300	
2023 ICSG DIRECTORY OF COPPER AND COPPER ALLOY FABRICATORS (single issue)	€550	€1,100	
The Mineral Composition and Regulation of Copper Concentrates, Smelters and Refineries **(Mar 2023)**	€500	€1,000	
The Chinese Copper Smelter and Refining Industry **(Oct 2022)**	€700	€1,400	
North American Semi-Manufactured Copper Products Capacity, Output and Perspectives **(2021)**	€500	€1,000	
European Semi-Manufactured Copper Products Capacity **(2019)**	€500	€1,000	
Solid Wastes in Base Metal Mining, Smelting and Refining: A Comprehensive Study for the Copper, Lead and Zinc and Nickel Industries **(2019)**	€500	€1,000	
Smelting and Hydrometallurgy Treatment for Copper Sulfide Ores and Concentrates **(2019)**	€500	€1,000	
Copper Use in Fabrication in Japan, Korea, Taiwan (China) and Vietnam **(2018)**	€500	€1,000	
Industrial Use of Refined Copper and Scrap in Fabrication in China **(2017)**	€300	€600	
Manufacture and Use of Semi-Fabricated copper in Latin America/Canada **(2017)**	€300	€600	
China Copper Mining Industry **(2016)**	€500	€1,000	
Social Acceptance for Mineral and Metal Projects **(2016)**	€250	€500	
The By-Products of Lead, Zinc, Copper and Nickel – Updated **(2015)**	€500	€1,000	
Fabrication and Copper Use in Indian Subcontinent, ASEAN and Oceania **(2015)**	€250	€500	
Survey of Brass Mills, Copper Products and Foundries in China **(2014)**	€250	€500	
Cobalt as a By-Product of Copper and Nickel **(2014)**	€250	€500	
Taxation, Royalties and Other Fiscal Measures Applied to the Non-Ferrous Metals Industry **(2013)**	€250	€500	
TOTAL ORDER			

To subscribe to ICSG publications please fill in this form and send to mail@icsg.org

Name _____

Company _____

Address _____

_____City_____

Postal Code_____ Country_____

Tel_____

Email_____

Date_____

Signed_____

METHOD OF PAYMENT

□ Bank Transfer:

For Bank transfer payments please contact the secretariat at mail@icsg.org. All banking charges regarding this remittance will be paid by the buyer.

□ By Credit Card (VISA or MasterCard)

We accept VISA and MasterCard. If you wish to pay with a Credit Card, please ask the ICSG secretariat at mail@icsg.org for the 3D Secure Payment link.

(*) ICSG Members refers to orders originating from institutions based in ICSG member countries. ICSG member countries are Australia, Belgium, Brazil, Chile, China, D.R. Congo, Finland, France, Germany, India, Iran, Italy, Japan, Kazakhstan, Luxembourg, Mexico, Mongolia, Peru, Poland, Portugal, Russian Fed., Serbia, Spain, Sweden and the U.S.A.

International Copper Study Group

Rua Almirante Barroso 38 – 6th

1000-013 Lisbon, Portugal

Tel: +351-21-351-3870 Fax: +351-21-352-4035

e-mail: mail@icsg.org

Web site: www.icsg.org