

SECTOR
REPORTS

70th
year



ISTANBUL
CHAMBER OF INDUSTRY

TURKISH COPPER AND COPPER ALLOYS MANUFACTURING INDUSTRY



Istanbul Chamber of Industry Professional Committees
Sector Strategies in Global Competition Project

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FOREWORD



One of the most challenging issues for the industrial sector in the world in recent years has been the developments regarding the supply of raw materials and commodity markets. Important developments such

as global trade tensions, carbon emission laws, the COVID-19 pandemic and the Russia-Ukraine war took place in a very short period of time. Uncertainty and sometimes severe price shocks were experienced in many areas such as production, supply, transportation and pricing.

It seems that the raw material problem, in terms of both supply and price fluctuations, will remain at the top of the economy's agenda in the coming years. The global crisis in semiconductors, where hundreds of billions of dollars of investments are made today, and which caused production disruptions in many sectors during the pandemic was perhaps the most striking example of this.

Copper and copper alloys, among the first products that come to mind when metal raw materials are mentioned in the industry, are also at the focal point of all these developments. Copper has an indisputable strategic importance with its important physical properties, especially conductivity, and its indispensability in electrical-electronic products that now cover all areas of our lives. Being one of the first metals used by humanity

and the first alloy component make copper an ancient material. And the importance that electric vehicles and renewable energy production will gain in the coming decades carries the value of copper to the future.

Despite its position as a net importer in the sector, Türkiye is among the top 10 countries in refined copper production capacity and consumption. Copper and its alloys indirectly contribute to the added value of our country as they are used as inputs in key exporting sectors such as automotive, white goods and construction. In this sector, there are companies that can manufacture products at international standards and have the ability to adapt to market and demand conditions. And Türkiye is a candidate to take a share from the transformation in global value chains with its technical knowledge and experience as well as its proximity to growing geographies.

On the other hand, this globally highly competitive sector needs to be supported more in the current uncertain and volatile market environment in order to make the best use of its potential in our country. Improvements in many fundamental issues such as raw material supply security and quality, trade barriers, technology and R&D infrastructure, compliance with green transformation legislation, and qualified personnel shortage are critical for the sector to achieve its goals.

In this direction, this study aims to address the copper sector in terms of its basic sizes, domestic and international trends, near-term expectations, and problems and advantages in our country, and to reveal policy recommendations and road maps for the future.

As the Istanbul Chamber of Industry, we have created a significant accumulation with the “ICI Professional Committees Sector Strategies Project in Global Competition”. Within the scope of the ongoing project with the valuable contributions and participation of our professional committees and sector representatives, our sector reports series has reached 27 books, including this study.

During the preparation process of the report, the workshop, which was held with the participation of the leading representatives of the sector, played a major role in enriching the content. In addition to our workshop participants for their invaluable contributions to the report, I would like to thank the members of the ISO 38th Group Copper, to Copper Alloys and Heavy Metals Industry Professional Committee, to Consulta Arařtırma team that prepared the report, and to the employees of the ICI Economic Research and Corporate Finance Branch who coordinated the entire process.

Erdal BAHÇIVAN
Istanbul Chamber of Industry
Chairman of the Board of Directors





EXECUTIVE SUMMARY

“Mining made by the State in Türkiye is one of the important issues closely related to national development efforts. Apart from our general industrialization idea, we have to maintain and give special importance to the mineral exploration and operation, first to increase our foreign loan opportunities and our foreign exchange income. We must ensure that the Mineral Research and Exploration Department develops its activities and that the minerals to be found are put into operation immediately in a planned manner after the profitability calculations are made. A three-year plan should be made for the most important mines of the available ones.”

Mustafa Kemal ATATÜRK

1 November 1937 Grand National Assembly of Türkiye,
5th Term 3rd Legislative Year Opening Speech

Today, at a time of a new energy transition, copper is at the forefront of this transition as a 100% recyclable, conductive, flexible, efficient and clean energy source. Increased digitalization and “green demand” have positioned copper as one of the main elements of sustainability and its use in renewable energy sources such as wind and sun, and being a critical raw material in electric vehicle production have made copper indispensable in this new energy transition. “Copper is the new oil” and from this perspective, it is a strategic mineral.

It is expected that the demand for copper and its alloys will increase day by day due to its critical use in emerging sectors such as electric vehicles and renewable energy and with the effect of developing technology. And the green energy sector is expected to play a locomotive role in this increase. Despite the ever-increasing demand for copper, copper investments worldwide are not ready to meet the need for this wide range of use from wind turbines to electric cars, to white goods and to healthcare, according to experts. Making copper production investments, which are quite costly, in the short term will provide a strategic advantage in the long run.

Developing new technologies and production techniques used in exploration and extraction activities, reducing exploration and extraction costs, and giving importance to recycling are extremely important for the continuation of global supply. Given the fact that

the ocean floors covering 70% of the earth contain rich underground resources, deep-sea mining will also come to the fore as an important business model for the future in providing this supply; and early investments in high-cost seabed deposits will be of strategic importance.

In the copper sector, Türkiye does not have sufficient mineral resources and processing facilities (our only smelter belongs to Eti Bakır and its annual capacity is approximately 90 kilotons), and is 72% foreign-dependent for raw materials. This caused Türkiye to have a current account deficit of 1.5 billion dollars in 2020 and was directly affected by the changes in raw material prices.

Another reason of the copper industry’s strategic importance is its positive impact on reducing Türkiye’s current account deficit. That is, although Türkiye seems to have a current account deficit because it imports raw materials and makes a large part of its sales domestically, in fact, thanks to the copper sector, it brings value-added products to the country and becomes an indirect exporter.

The copper industry has been given an important place in the applicable 11th National Development Plan. In this plan, some measures have been planned such as establishment of a Copper Institute to support R&D activities and integrate the industry with the world, and making an import-export regulation to be permanent

in the EU market, and taking the necessary political and economic actions to direct the production activities, which tend to shift from West to Eastern Europe, to our country. In addition, reducing our copper raw material exports and processing it in our own smelters into refined copper in the country is seen as a right step for our country, which is dependent on foreign raw materials.

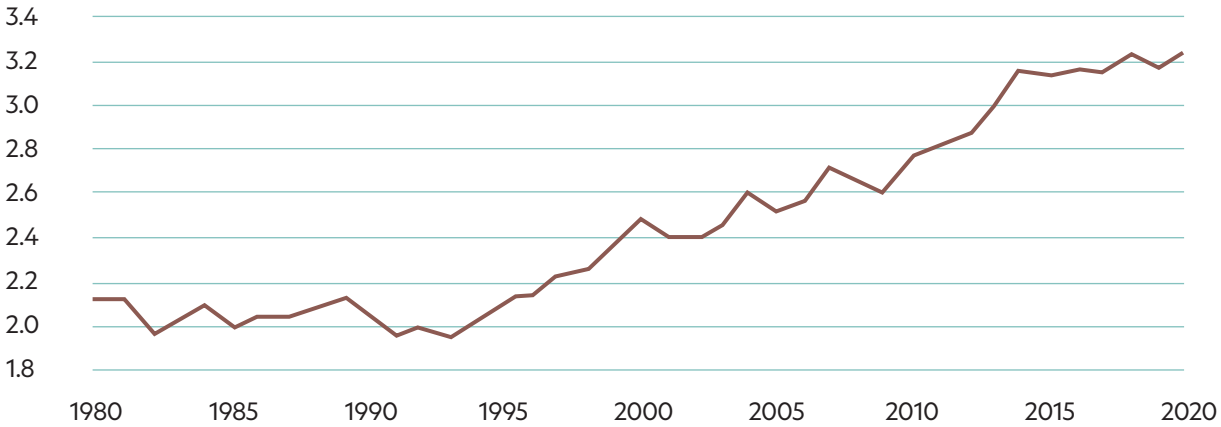
Although the sector productivity in Türkiye has increased by 58% from 2010 to 2019, there is still idle capacity. The utilization rate of the base metal industry capacity is 80%. If the right arrangements are made in the fields of legal, administrative, infrastructure, logistics and R&D, Türkiye has the potential to grow in sectors with high base metal consumption such as the automotive and shipbuilding industry, and even to become an automotive production base in its region thanks to its advantageous position in terms of

logistics and transportation. In addition, the Turkish industry has the experience and opportunity to take a share in the refined copper production activities that have moved from the West to Eastern Europe. If these opportunities are taken, it will also contribute to the revival of the idle capacity and thus to the rise in employment.

Humankind's acquaintance with metals began with the discovery of gold 12 thousand years ago and copper 8 thousand years ago. Gold and copper are very soft metals. Since copper can be found more easily and in greater amounts than gold, it is the first mass metal used by humanity. Copper consumption per capita, which was approximately 2.1 kg in 1980, increased to approximately 3.2 kg in 2020. Per capita copper consumption was calculated by dividing the annual refined copper consumption of the copper industry by the world population.

Source: International Copper Study Group (ICSG, 2021) and World Bank.

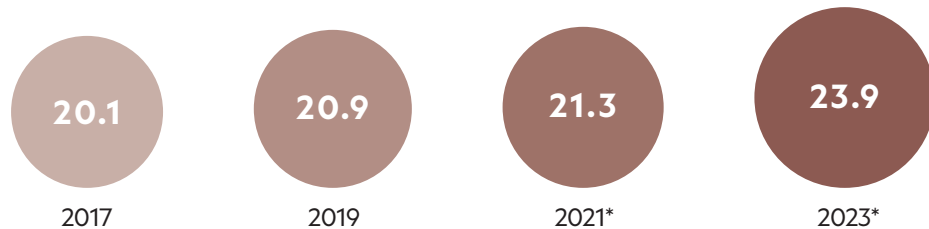
Figure 1: Per Capita Copper Consumption (Kilogram)



The copper industry consists of 3 sectors. The miner producing copper ore, the refined copper producer who processes and purifies the ore, and the finished goods producer using refined copper.

**Figure 2:
Copper Ore
Production Amount
(Million Tons)**

Source: Wood Mackenzie (2021).
*Includes estimated values.





EXECUTIVE SUMMARY

Figure 3:
Refined Copper
Production Amount
(Million Tons)

Source: Wood Mackenzie (2021).
*Includes estimated values.

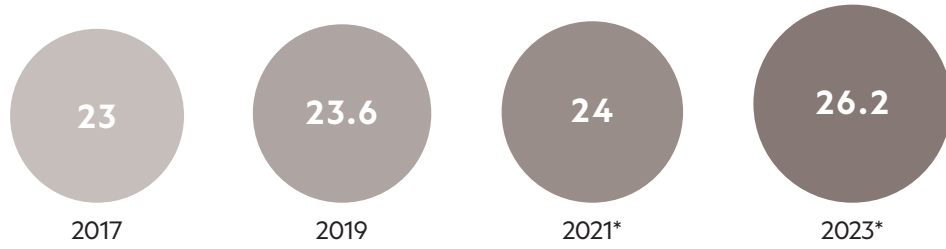
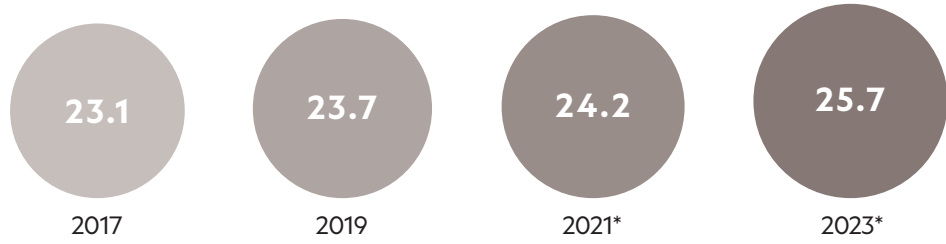


Figure 4:
Refined Copper
Consumption
(Million Tons)

Source: Wood Mackenzie (2021).
*Includes estimated values.



Source: Wood Mackenzie (2021).

Table 1: Copper Industry Compound Annual Growth Rates (%)

	2017-2019	2019-2021	2021-2023
Copper Ore Production (Metal Based)	2.12	0.80	5.92
Refined Copper Production	1.32	0.78	4.57
Refined Copper Consumption	1.28	1.16	2.97

The production and trade figures of the copper and copper alloys sector, obtained from different sources, are shown in Table 2. As the copper ore trade is not done with pure copper amount, the pure copper figures appear in larger amounts than the production.

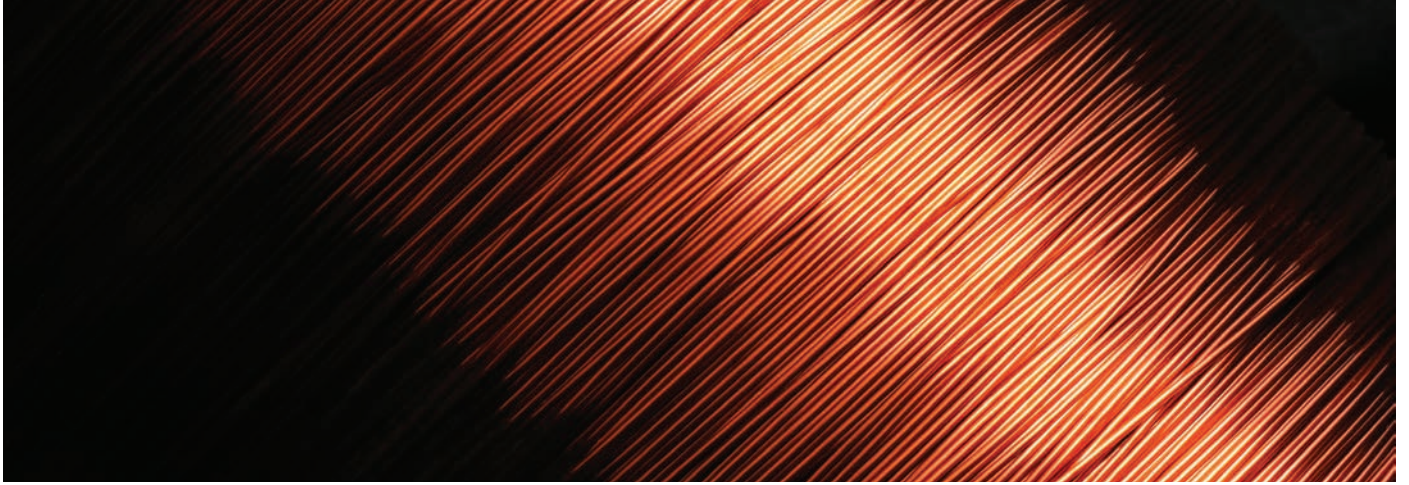
Kaynak: Wood Mackenzie (2021).

Table 2: Copper Industry Production and Trade Figures (Million Tons)

	ICSG	World Bank	Wood Mackenzie		Trademap			
	2020	2020	2020	2021	2020 EXPORT	2020 IMPORT	2021 EXPORT	2021 IMPORT
Copper Ore Production (Metal Based)	20.6	20.5	21.0	21.3				
Copper Ore Trade					35.5	37.4	37.7	37.8
Refined Copper Production	24.5	23.9	24.0	24.0				
Refined Copper Trade					8.8	10.5	9.3	9.6
Refined Copper Consumption	25.0	24.8	23.5	24.2				
Finished Goods Trade					6.0	5.7	7.0	6.2



INTRODUCTION



Copper, one of the first metals mined by humanity, has been widely used by humans throughout history. In the early days, copper was found pure in nature and various items used in daily life were made by using hammers to shape it. Although it can be melted with charcoal (1083 degrees Celsius) and is easily shaped, and has superior characteristics, its easy fatigue and breaking has limited the use of the article and the use of tin was preferred. The bronze (bronze) alloys formed by melting copper with tin is the first alloy in history and caused the transition from the Stone Age to the Bronze (Bronze) Age. It was determined that the first place where copper and copper alloys were produced was the Elazığ-Maden-Çayönü finds 8 thousand years ago.

Used in the production of various daily life items, money and weapons in the early ages, copper is widely used in the electrical and electronic industry today. It is the metal that best conducts electricity and heat among the base metals. It also has antimicrobial properties. The role of copper in human life is increasing day by day as the electrical and electronics sector is becoming increasingly widespread and stronger. Another sector in which copper is most widely used after the electrical and electronics sectors is the construction sector.

COPPER AS AN ELEMENT

Symbol: Cu
Atomic Number: 29
Atomic Mass: 63.54
Intensity: 8.96 g/cm³
Melting Point: 1,358 K (1,085 °C)
Thermal conductivity: 401 W/(m*K)
Thermal expansion (25 °C): 16,5 µm/(m*K)
Crystal Structure: Face Centric Cubic

The English name for the element copper, "Copper", is derived from the Latin word "Cyprium". It means "Cyprus metal".

DEFINITIONS ABOUT COPPER

Tenor: Indicates the amount of metal found in an ore.
Run-of-mine Copper: The ore extracted from the mineral deposit and without any treatment is called run-of-mine (minimum 0.2% copper grade).
Concentrated Copper: Ore (10-45% copper grade) usually enriched by flotation.
Blister Copper: Copper metal with a purity of 98-99%.
Cathode Copper: Copper metal with a purity of 99.9%.
Primary Copper: It is used for copper metal formed by processing copper extracted as ore or for chemicals containing copper.
Secondary Copper: Recycled copper metal by fire refining or smelting of copper scrap into anode.



DEFINITION AND SCOPE OF THE SECTOR



The scope of the sector consists of copper and its alloys. The primary alloys are those with zinc, which are generally called brass. Brass is divided into alpha and beta groups, up to 3% lead can be added to the alloy for easy processing of these brasses. When we look at the other alloys of copper, it is seen that it has alloys with tin, manganese, aluminum and other metals. It is possible to divide them into two groups as copper and its alloys.

The scope of the sector for the report has been determined using HS and NACE codes. HS is the abbreviation of Harmonized System. “GTIP” is the Turkish abbreviation of the term (Customs Tariff Statistics Position). HS is defined as the standard coding structure and related product descriptions used in international trade. HS has been developed and maintained by the World Customs Organization (WCO), based in Brussels, Belgium, which has more than 179 members. The HS Code assigns specific six-digit codes

for varying classifications and goods. Countries are allowed to add longer codes to the first six digits for more detailed classification.

Abbreviation of the NACE is “Nomenclature statistique des activités économiques dans la Communauté Européenne” It can be translated into English as “Statistical classification of economic activities in the European Community”. The NACE code gives the field of business of the workplace and, in connection with it, the workplace hazard class information.

Prodcom is the classification of goods used for industrial production statistics in the EU.

As can be seen in Table 3, the general group HS Code is 74 which is under the heading “Copper and Copper Products”. Under this heading, imports and exports of HS codes 7414, 7416 and 7417 are not followed up. The NACE code of the sector is also included under the title of Copper Production, as seen in Table 4.

Table 3: HS Codes of the Sector

HS CODE	Product Description
7401	Copper mattes; precipitated copper (sterip copper)
7402	Unrefined copper; copper anodes for electrolytic refining
7403	Refined copper and copper alloys (crude)
7404	Copper waste and scrap
7405	Pre-alloys of copper (cupro alloys)
7406	Copper powders and copper flakes
7407	Copper bars and profiles
7408	Copper wires
7409	Copper sheets, plates, leaves and strips (thickness > 0.15 mm)
7410	Copper leaves and strips (thickness ≤ 0.15 mm)
7411	Thin and thick copper pipes
7412	Thin and thick copper pipe fittings (such as unions, elbows, sleeves)
7413	Wires, cables, braided ropes and such (other than electrically insulated) of copper
7415	Nails, tacks, threaded nails and such, of copper or heads of copper and bodies of iron and steel (other than those of heading 83.05); copper bolts and nuts, hook screws, rivets, pins, wedges, washers (including springing washer) and similar goods
7418	Table, kitchen and other household goods, health-protective articles and parts thereof, made of copper; sponges, cleaning and polishing articles, gloves and the such, of copper
7419	Other goods of copper

Table 4: NACE Codes of the Sector

NACE CODE	Product Description
24.4.4.01	Manufacture of copper, copper matte, copper powder, cemented copper, copper anode and copper and copper alloys
24.4.4.03	Manufacture of copper sheet, plate, strip, foil (including those made of alloy)
24.4.4.04	Production of tubes, pipes, their fasteners, bars, rods, wire and profiles (including those made of alloy) by drawing and rolling of copper



DEFINITION AND SCOPE OF THE SECTOR



The detailed breakdown of the sector by product and the equivalents of the products as HS codes are given in Table 5.

Source: International Copper Study Group (ISCG).

Table 5: Distribution of Products in the Sector by HS Codes

Copper ores and enriched copper ores		2603
Copper mattes; precipitated copper (precipitated copper)		7401
Unrefined copper; copper anodes for electrolytic refining		7402
Refined Copper	Cathodes and cathode parts	7403 11
	Wire rods	7403 12
	Logs	7403 13
	Others	7403 19
Ingot	Copper Alloys	
	Cu-Zn	7403 21
	Cu-Sn	7403 22
	Other copper alloys	7403 29
	Pre-alloys of copper (cupro alloys)	7405

Table 5: Distribution of Products in the Sector by HS Codes (Continued)

Products

All

Powders and Fine flakes	7406
Bars and Profiles	7407
Wires	7408
Sheets, Plates, Leaves and Strips (Thickness > 0.15 mm)	7409
Thin leaves and strips (Thickness < 0.15 mm)	7410
Pipes	7411
Copper	
Bars and Profiles	7407 10
Wires	
Thickness > 6 mm	7408 11
Others	7408 19
Sheets, Plates, Leaves and Strips (Thickness > 0.15 mm)	
In Rolls	7409 11
Others	7409 19
Thin leaves and strips (Thickness < 0.15 mm) (Unsupported)	7410 11
Thin leaves and strips (Thickness < 0.15 mm) (Supported)	7410 21
Pipes	7411 10

Copper Alloys

Bars and Profiles	
Cu-Zn	7407 21
Others	7407 29
Wires	
Cu-Zn	7408 21
Cu-Ni, Cu-Ni-Zn	7408 22
Others	7408 29
Sheets, Plates, Leaves and Strips (Thickness > 0.15 mm)	
Cu-Zn, in Rolls	7409 21
Cu-Zn, Others	7409 29
Cu-Sn, in Rolls	7409 31
Cu-Sn, Others	7409 39
Cu-Ni, Cu-Ni-Zn	7409 40
Others	7409 90
Thin leaves and strips (Thickness < 0.15 mm) (Unsupported)	7410 12
Thin leaves and strips (Thickness < 0.15 mm) (Supported)	7410 22
Pipes	
Cu-Zn	7411 21
Cu-Ni, Cu-Ni-Zn	7411 22
Others	7411 29

Scrap

Copper waste and scrap	7404
From refined copper	7404 00 10
From copper alloys	
Cu-Zn	7404 00 91
Others	7404 00 99



PART:
GLOBAL
OUTLOOK OF
THE SECTOR



1.1. General Trends Affecting the Sector

1.1.1. Sustainability

The structure of copper, which is 100% recyclable, makes it a clean energy source. These properties make copper a critical material for wind and solar technology, energy storage and electric vehicles. According to the USGS, recycling of copper scrap in the United States meets 38% of copper needs and 16% worldwide (United States Geological Survey (USGS), 2021).

Copper;

- A good conductor of heat and electricity.
- Ideal for electrical work as wire and sheet.
- 20% less material is used compared to other sources used in electric motors, transformers and cables.
- Copper is 100% recyclable and can be used over and over again without losing its engineering properties. (Copper Alliance)

The Copper Industry shares a very close focus with 5 of the UN Sustainable Development Goals. These are:

- 3 Health and Quality of Life
- 7 Accessible and Clean Energy
- 11 Sustainable Cities and Communities
- 12 Responsible Production and Consumption
- 13 Climate Action

1.1.2. Innovation

Developing technology has created new areas of use for copper and its alloys, thus diversifying and increasing the demand for copper. Some new copper applications under development include:

- **Electric Vehicles** – It stands out as one of the emerging sectors where copper and its alloys are used extensively. (Electric vehicle sales are expected to reach 10.5 million units in 2025, from 3.1 million units in 2020 and 6 million units in 2021, to an estimated 21.7 million units by 2030.)

- **Antimicrobial Applications** – Lead-free copper alloys are candidates to replace plastic in applications such as sterile tabletops and medical car handles.
- **Renewable Energy** – Copper plays a key role in clean energy. Many systems, from wind to solar power plants, support the demand for copper and its alloys.
- **Ultra-Conductive Copper Components** – Technologies are being developed that promise major efficiency improvements in transmission and distribution networks, thanks to methods of incorporating nanocarbon materials into copper.
- **Seismic Energy Dissipation** – Technologies to control building movements using energy-absorbing copper-based devices to reduce earthquake damage are on the agenda.
- **Aquaculture** – Aquaculture farms made with lead-free copper alloy mesh are an effective alternative to solving the problems faced by the near-shore fish farming industry.

1.1.3. Digitalization and Green Demand

- According to IDTechEx, 2.2 kilotons of copper were used for inverters and converters used in solar panels, wind turbines and electric cars in 2020. The amount of copper used for these products is estimated to be 6.7 kilotons in 2025 and 19.6 kilotons in 2030.
- The green energy transition (renewable energy, primarily wind and solar, and electric vehicles, as well as possible related upgrades and new electricity infrastructure) is believed to drive almost all growth in refined copper in the coming decades. It would be fair to say that the future growth of the global copper market is almost entirely dependent on a rapid green transition.



GLOBAL OUTLOOK OF THE SECTOR

- Green demand is expected to be 1 million tons in 2021, 2.5 million tons in the next 2-3 years, and approximately 6 million tons in 2030.
- Between 2000 and 2019, the use of refined copper reached 24 million tons with +62%. In 2035, copper consumption is expected to reach 32 million tons.

1.1.4. Copper Price

The main factors determining copper prices are industrial use of copper, periods of recession, changing trends and speculations in industry and technology. Copper prices have dropped eight times since 1970.

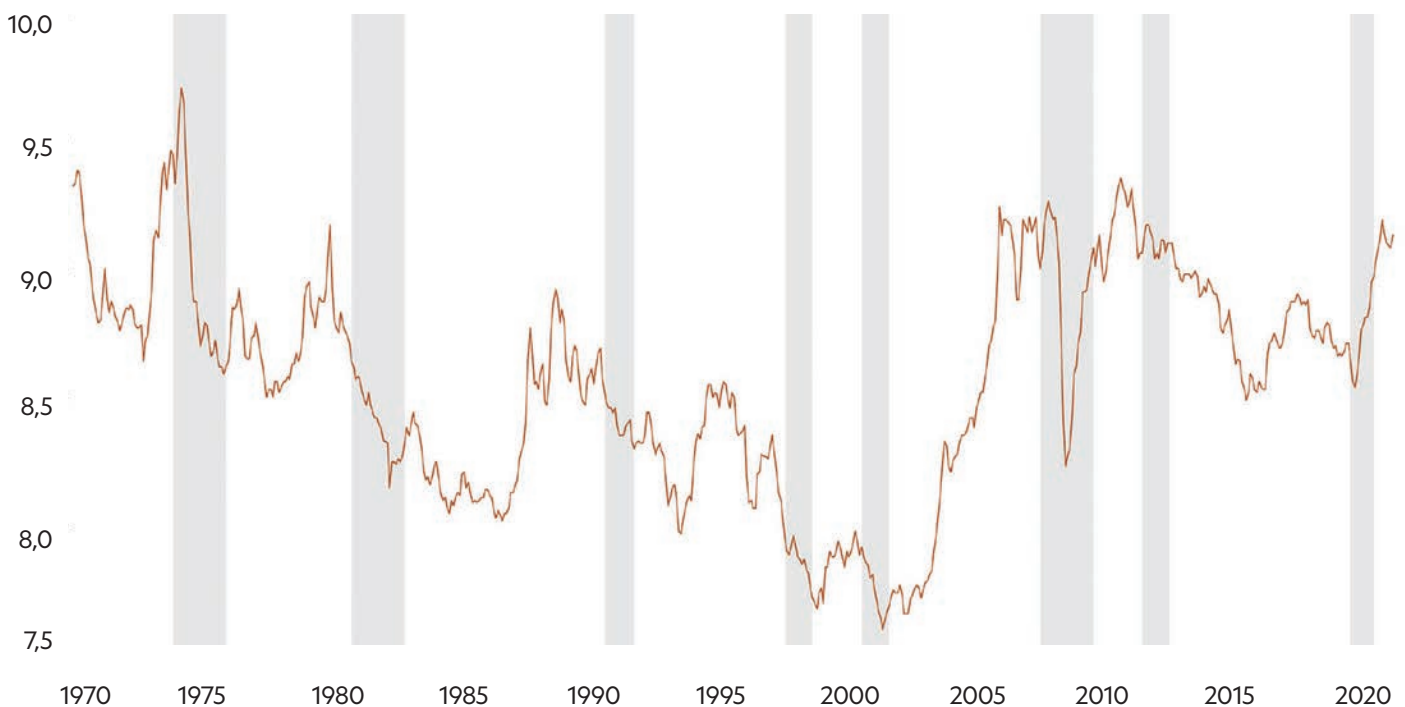
The declines were generally attributed to the global recession, slowdowns, shifting demand from copper to other materials in the name of technological innovation, and the emergence of new producers. Additionally, tensions in trade between the US and China also contributed to a sharp decline in prices in the second half of 2018.

Global recession and slowdowns: The price drops in 1999 and 2001 were driven by the recession associated with the global Asian financial crisis and the global slowdown in 2001, respectively. Similarly, copper prices fell sharply during the 1982 and 1992 global recessions and in 2020.

Source: The World Bank (2022).
Gray areas indicate periods of global recession.

Figure 5: Real Prices of Copper

Log (real price)



Real copper prices since 1970 are shown in Figure 5 logarithmically.

Technological innovations: In the 1980s and 90s, technological innovations reduced copper production costs. With the significant breakthroughs made in electrolytic copper production, copper production has increased notably.

Changing demand: Demand for copper in the last half century; replaced by aluminum, plastic and fiberglass. Aluminum gained a significant market share and affected the relative price of copper.

The emergence of new manufacturers: After a decade of stagnant ore production, new sources of supply and new technologies that lowered ore processing costs played an important role in lowering copper prices from 2011 to 2015. Mineral supply increased strongly during this period, with copper mine production increasing by 27 percent between 2010 and 2016 (World Bank, 2022).

Although copper prices correlate with world trade and growth in China, the US and the EU, copper prices are in line with Chinese economy and industrial growth as China is the world's largest buyer and consumes half of refined copper.

At a global level, copper prices rose by almost 130% between January 2016 and August 2021 (up 26.6% since January 2021), surpassing gold, silver and platinum. Before COVID-19, the price of copper was around \$5,800 per ton.

Commodity markets focused research company CRU predicts the 2022 copper price as \$8,700. While the World Bank observed a 51% increase in nominal copper prices in 2021 compared to the previous year, it predicts a 5% decrease in 2022.

Source: World Bank forecasts.

Table 6: Copper Raw Material Prices (Dollars/Tons)

	2019	2020	2021	2022	2023	2024	2025	2030	2035
World Bank	6,010	6,174	9,300	8,800	8,200	7,500	7,544	7,769	8,000



GLOBAL OUTLOOK OF THE SECTOR

1.2. Global Production and Foreign Trade

1.2.1. Amount of Global Copper Reserve

Looking at the world's copper reserves, Chile ranks first with 200 million tons, followed by Peru with 92 million tons. The total amount of copper reserves in the world is 870 million tons. The total amount of undiscovered and discovered copper reserves in the world is estimated to be 5.6 billion tons. Copper reserves have been at a level of reserves corresponding to 38 years of production since 1960. Since copper is an almost 100% recyclable metal, copper reserves are not expected to be depleted in the future.

On a global scale, 57% of copper reserves are found in the top five countries. These are Chile, Peru, Australia, Russia, Mexico, respectively. The copper reserve amounts of the first 12 countries and Türkiye given in Table 7 are shown on the map in Figure 6.

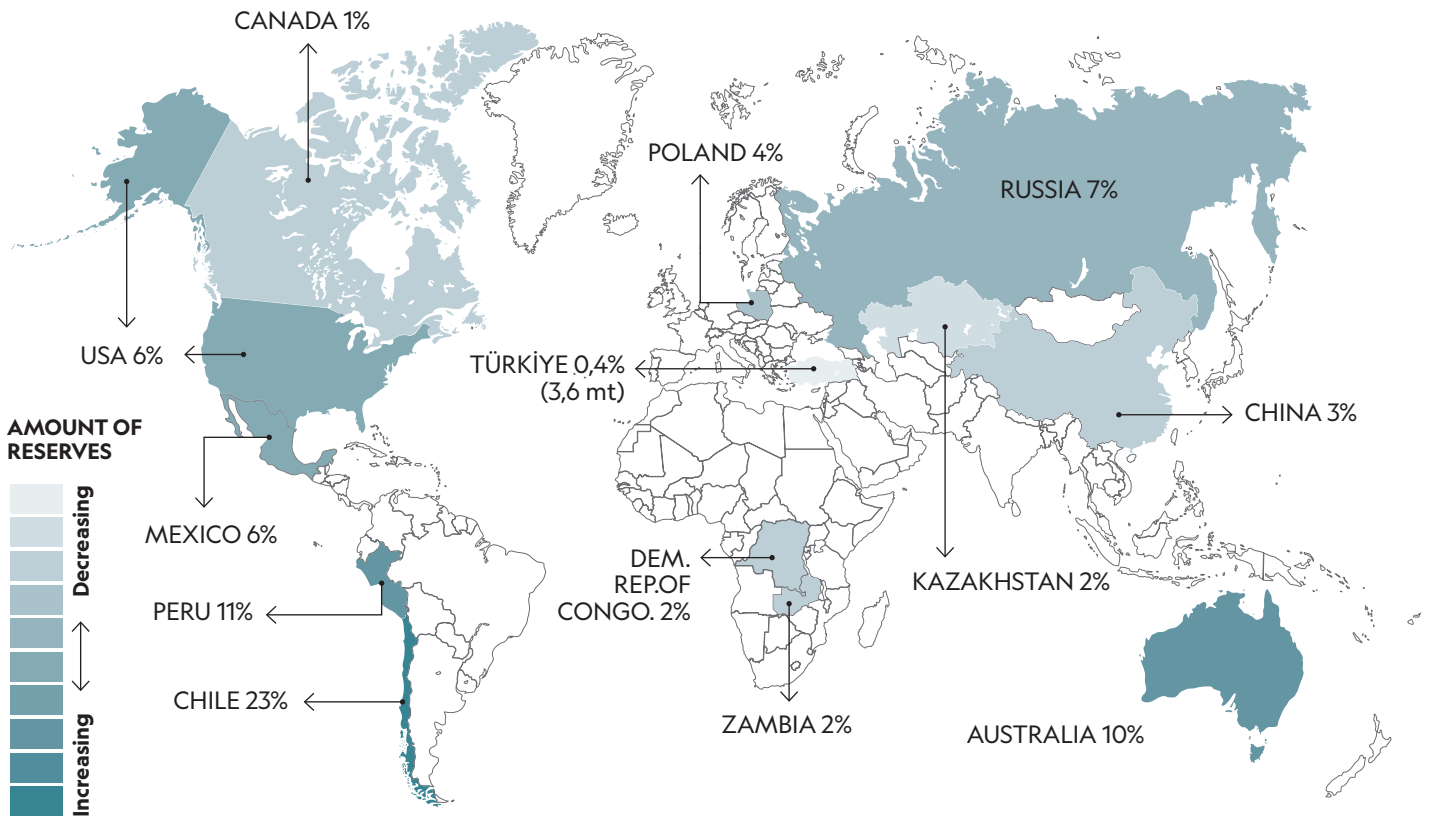
Source: USGS and MTA.

Table 7: World Copper Reserves

No:	Country	Capacity (Million Tons)	Share (%)
1	Chile	200	23
2	Peru	92	11
3	Australia	88	10
4	Russia	61	7
5	Mexico	53	6
6	United States of America	48	6
7	Poland	32	4
8	China	26	3
9	Zambia	21	2
10	Kazakhstan	20	2
11	Democratic Republic of Congo	19	2
12	Canada	9	1
	Other Countries	200	23
	Total	870	100
	Türkiye	3.6	

Source: USGS (2021).

Figure 6: 12 Countries with the Highest Reserves and Türkiye on the World Map

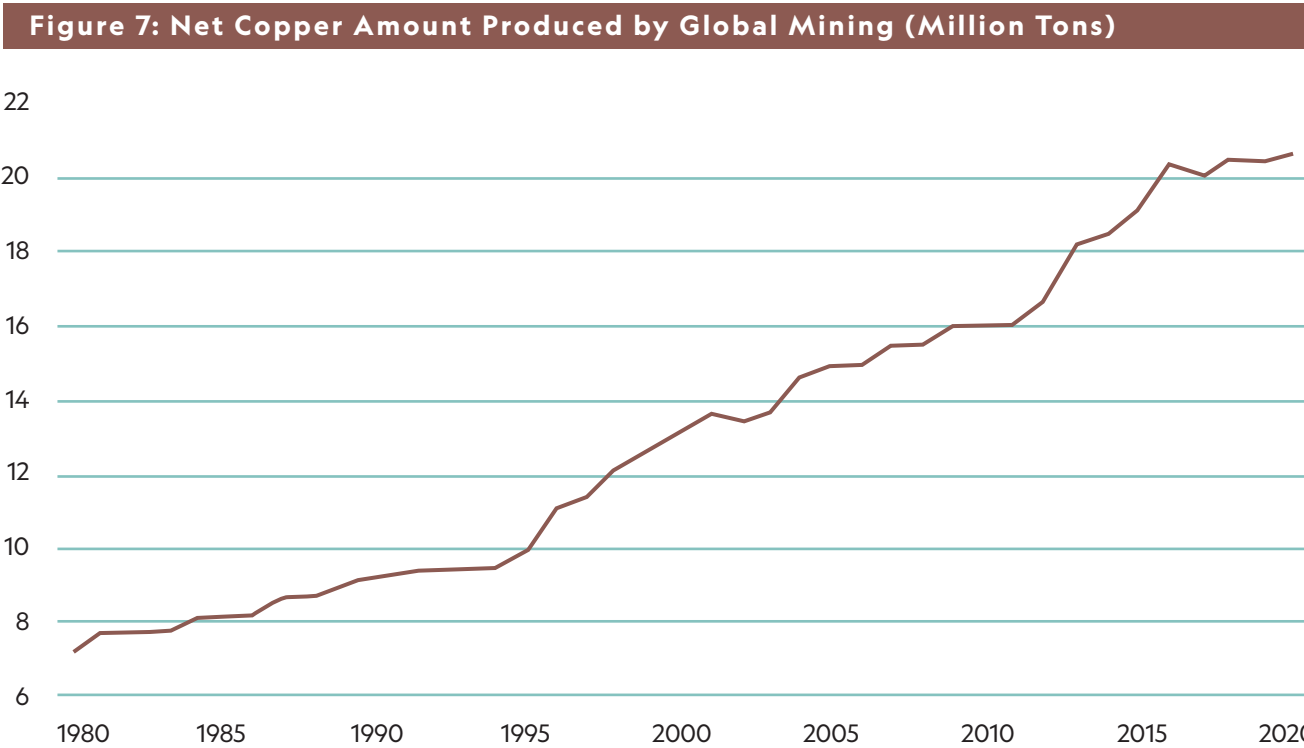




1.2.2. Global Copper Mining Production

Global copper ore production (on metal basis) in 2020 is 20.6 million tons (ICSG, 2021). Global copper ore production is constantly increasing.

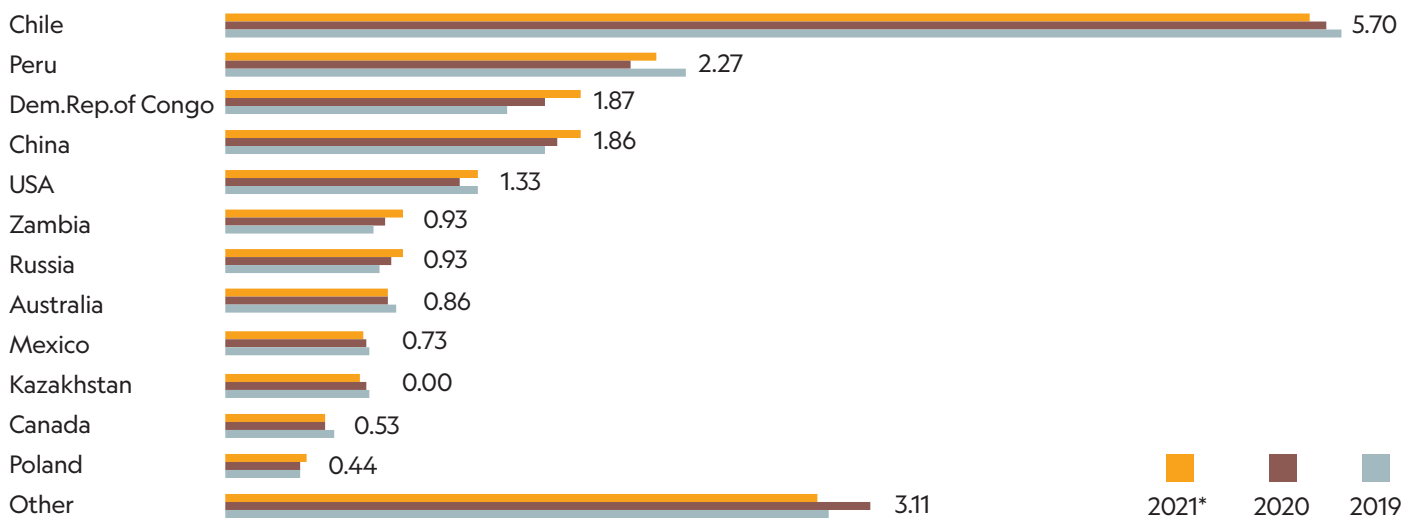
Source: USGS (2020).



Chile is the leader in global copper mine production. It is followed by Peru in second place and China in fourth place. Ranking 8th in terms of reserves, China ranks 4th in copper mine production. This actually shows how quickly China is extracting its reserves.

Source: Wood Mackenzie (2021).
 *Includes estimated values.

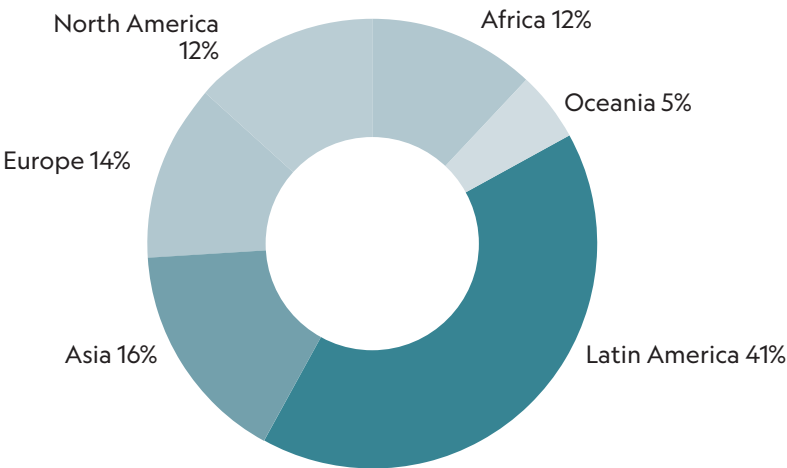
Figure 8: Top 12 Countries in terms of Net Copper Produced by Mining (Million Tons)



Latin America continent accounts for 41% of world ore production. Latin America is followed by Asia and Europe, respectively.

Source: ICSG.

Figure 9: Distribution of Net Copper Amount Produced by Mining by Continent





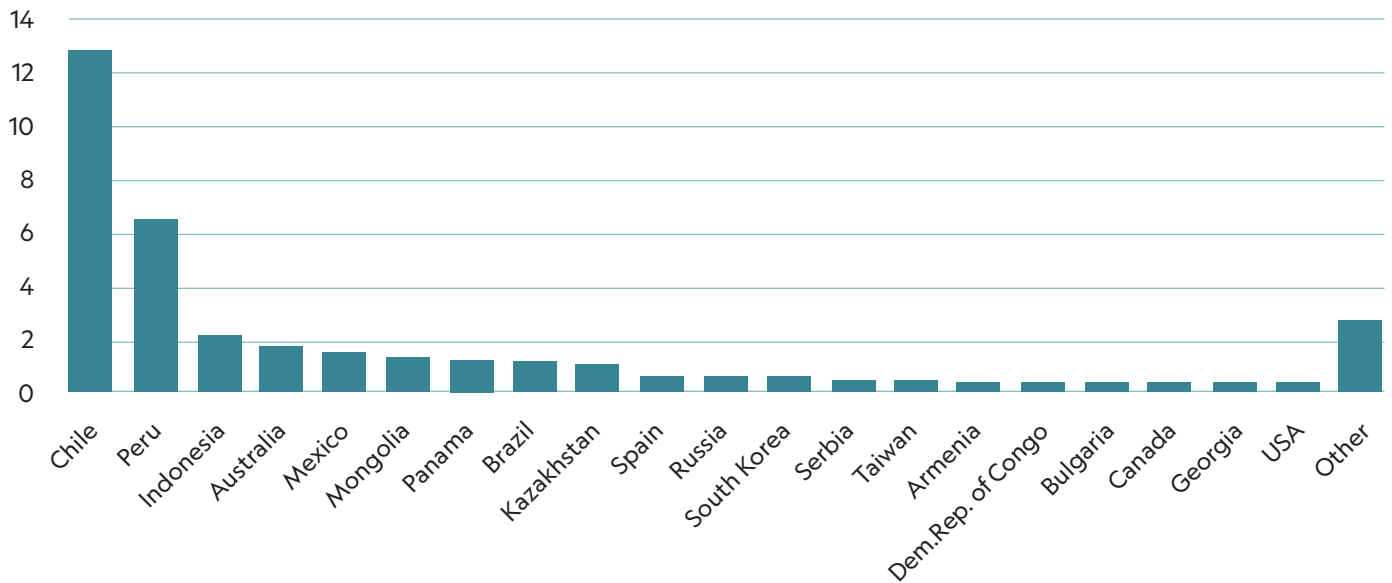
GLOBAL OUTLOOK OF THE SECTOR

1.2.3. Global Copper Mine Exports

Chile and Peru rank 1st and 2nd in exports and production, respectively. China, which ranks 4th in ore production, is not in the top 20 in ore exports. This shows that it creates added value by processing the ores produced in its country.

Source: Trademap.

Figure 10: Major Ore (Run-of-Mine and Concentrated Copper) Exporting Countries (Million Tons), 2021

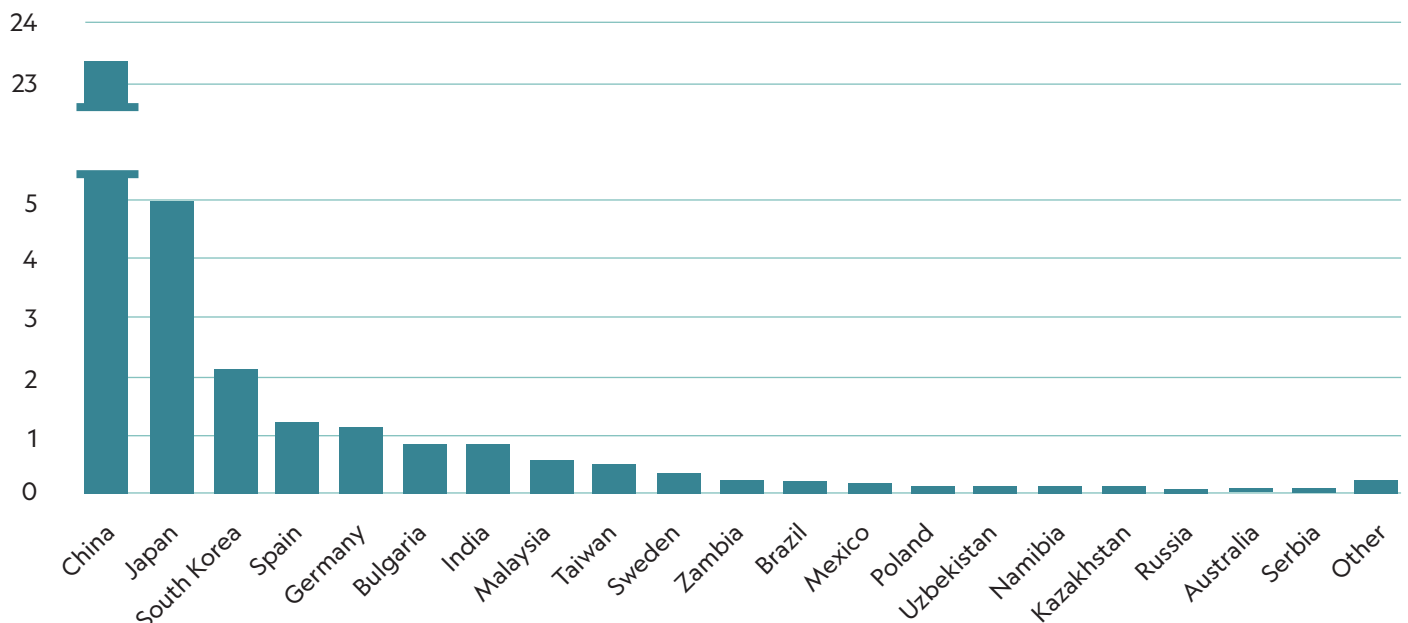


1.2.4. Global Copper Mine Imports

China accounts for 62% of global copper ore imports. This ratio is about 4.7 times that of Japan, which comes in the 2nd place.

Source: Trademap.w

Figure 11: Major Ore (Run-of-Mine and Concentrated Copper) Importing Countries (Million Tons), 2021

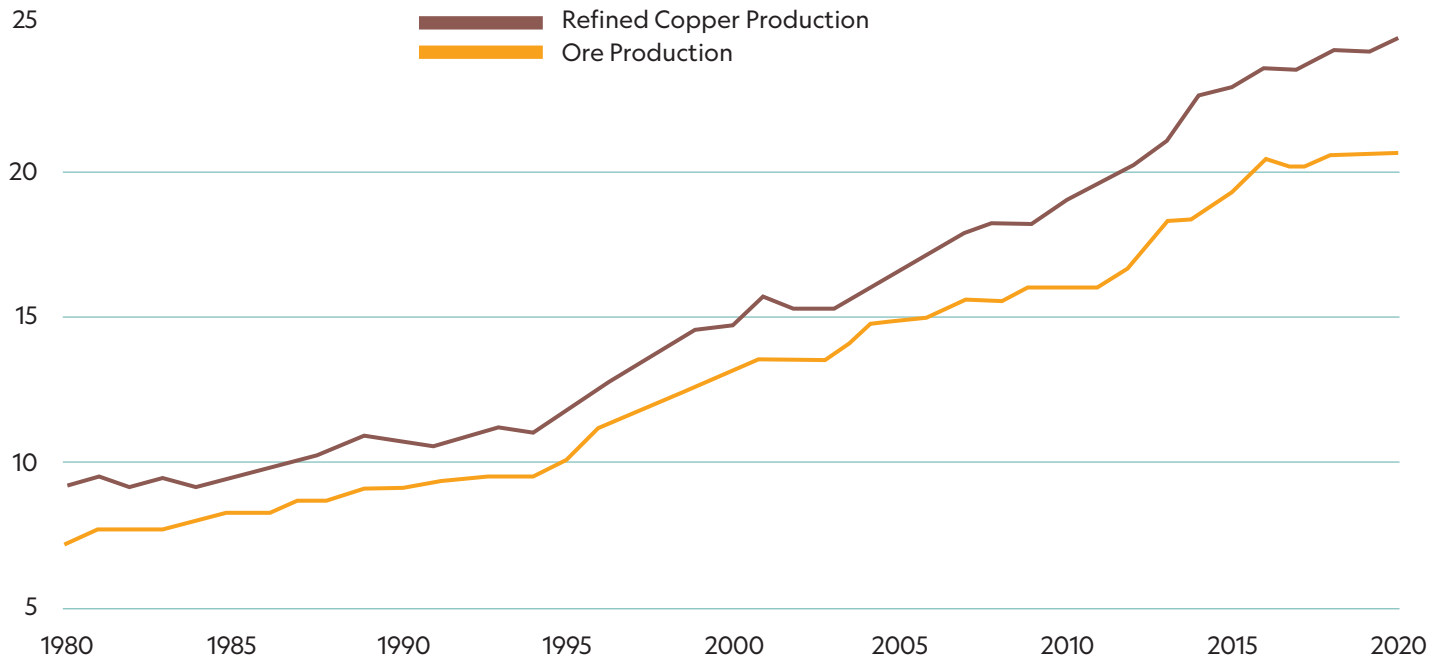


1.2.5. Global Refined Copper Production

As of 2020, global refined copper production is 24.5 million tons. The gap between global refined copper production and ore production is closing with scrap copper recycling. In 2020, approximately 3.9 million tons were recycled.

Source: ICSG

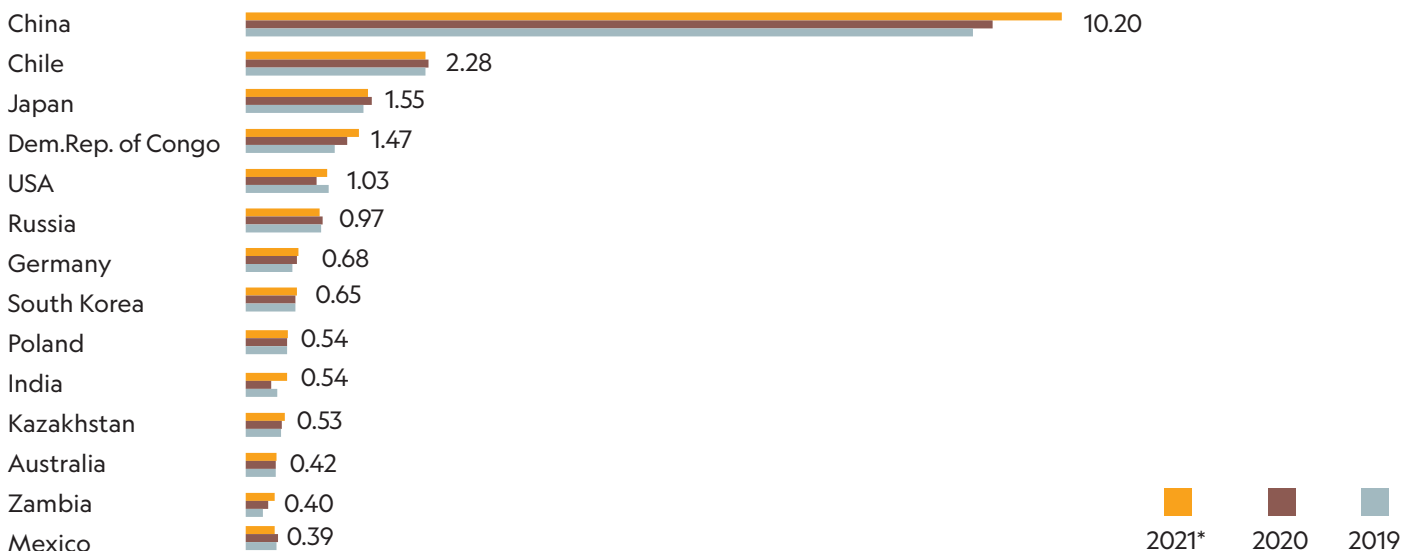
Figure 12: Global Refined Copper Production (Million Tons)



Chile falls to second place in global refined copper production, while China rises to first place in refined copper production with the ores it produces and imports. China's production accounts for about 42% of global refined copper production.

Source: Wood Mackenzie (2021).
*Includes estimated values.

Figure 13: Major Countries Producing Refined Copper (Million Tons)





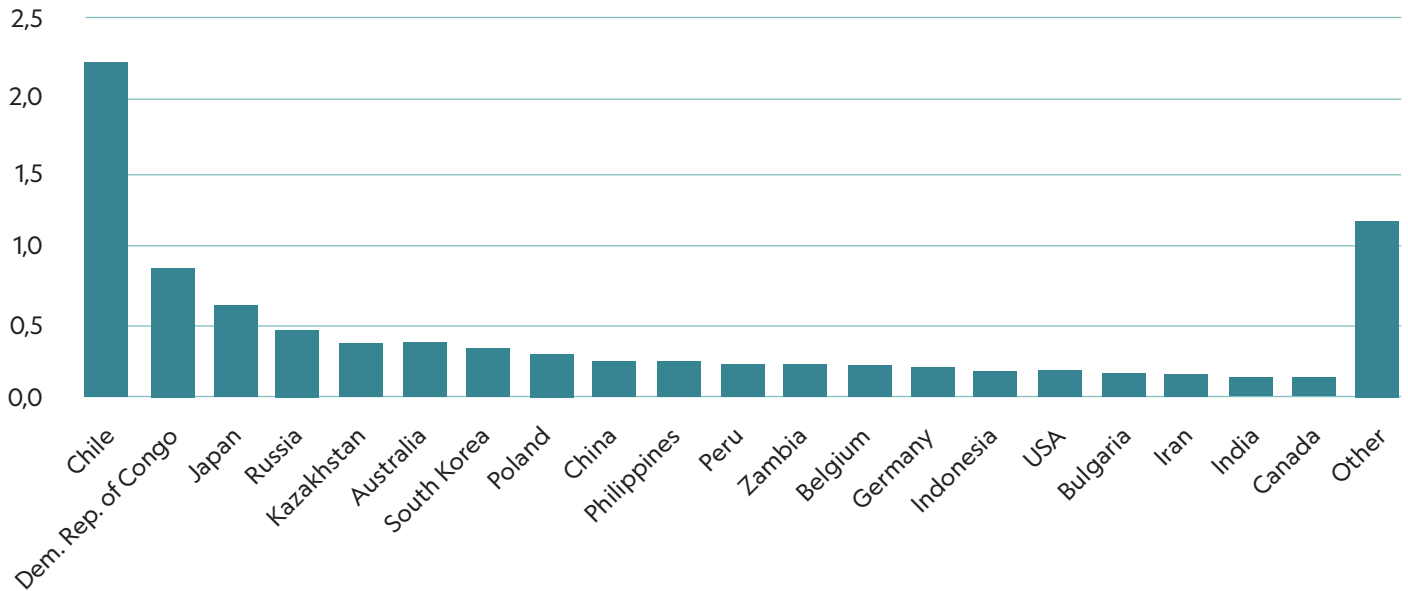
GLOBAL OUTLOOK OF THE SECTOR

1.2.6. Global Refined Copper Exports

China's refined copper exports, which ranks 1st in global refined copper production, are only 266 kilotons. Chile, which ranks 2nd, exports almost all of its production.

Source: Trademap.

Figure 14: Major Refined Copper Exporting Countries (Million Tons), 2021

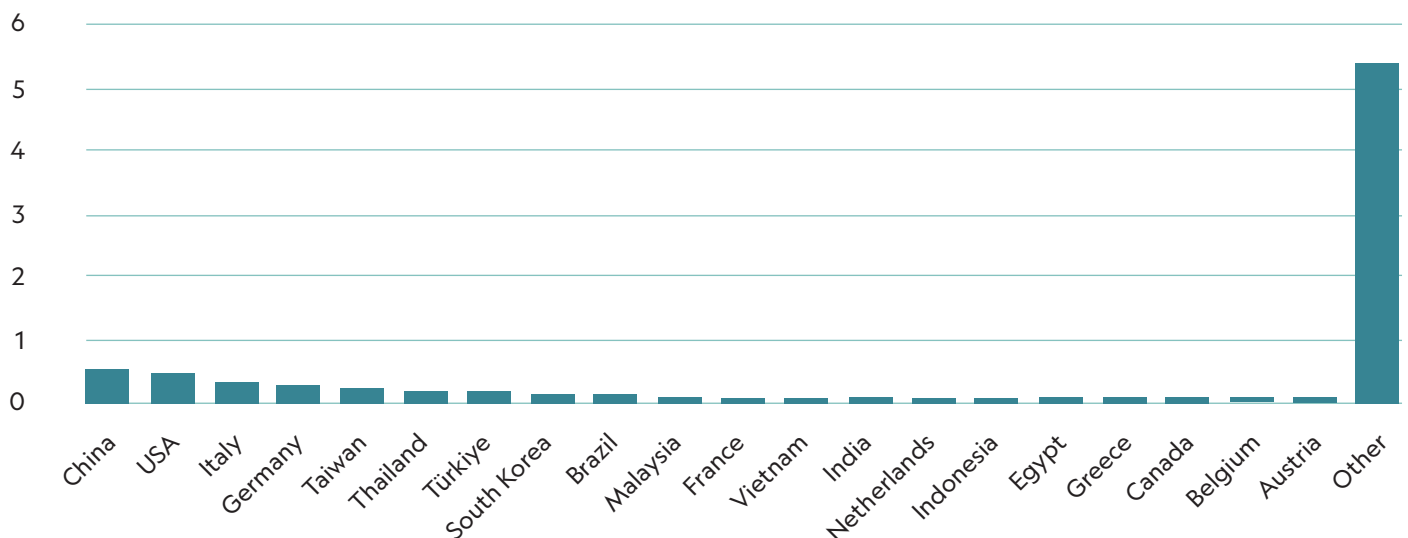


1.2.7. Global Refined Copper Imports

China, which ranks first in global refined copper production, also ranks first in global refined copper imports.

Source: Trademap.

Figure 15: Major Countries Importing Refined Copper (Million Tons), 2021

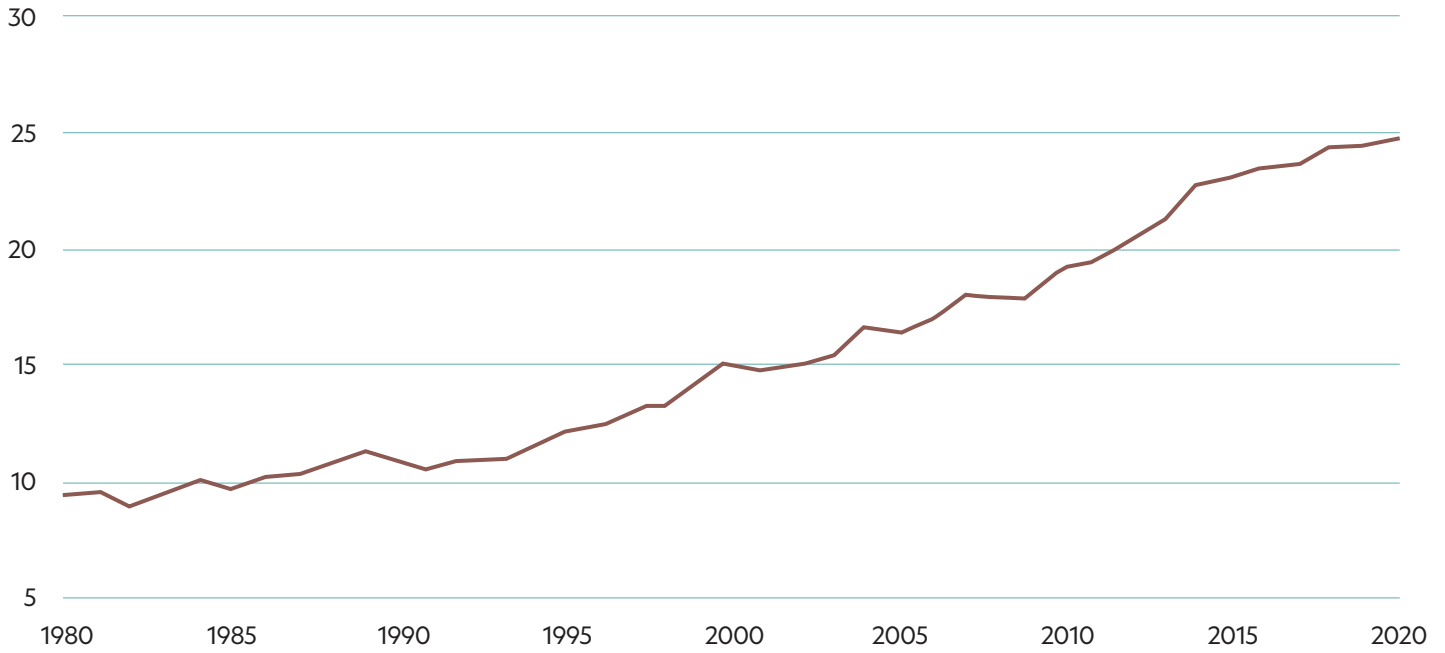


1.2.8. Global Refined Copper Consumption and Product Manufacturing

Refined copper consumption in 2020 is 25 million tons. Copper products are produced by using refined copper as raw material. Examples of copper products are wire, sheet, plate, pipe, profile and strip.

Source: ICSG.

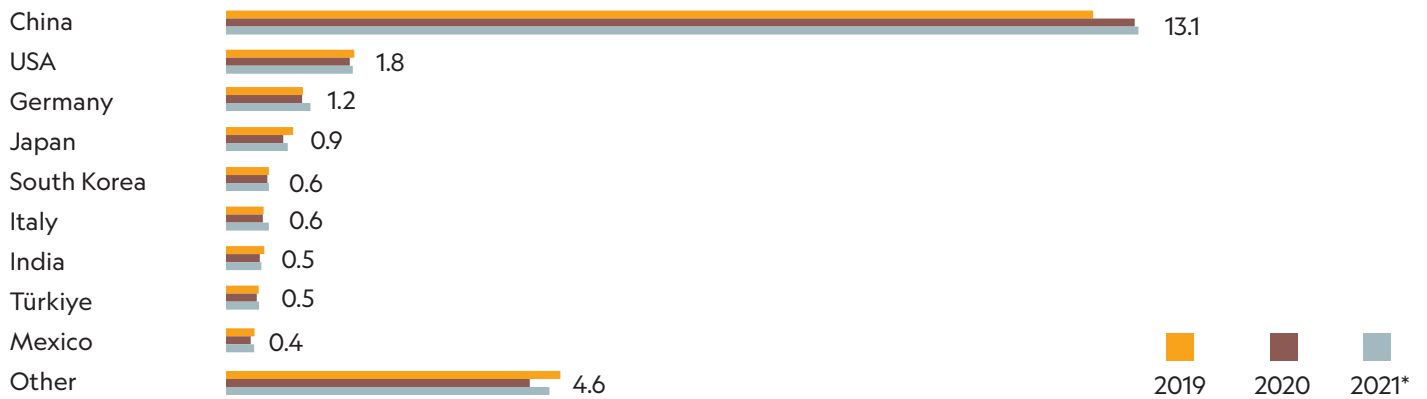
Figure 16: Global Refined Copper Consumption (Million Tons)



About 54% of global refined copper consumption is made by China.

Source: Wood Mackenzie (2021).
*Includes estimated values.

Figure 17: Major Countries Consuming Refined Copper (Million Tons)

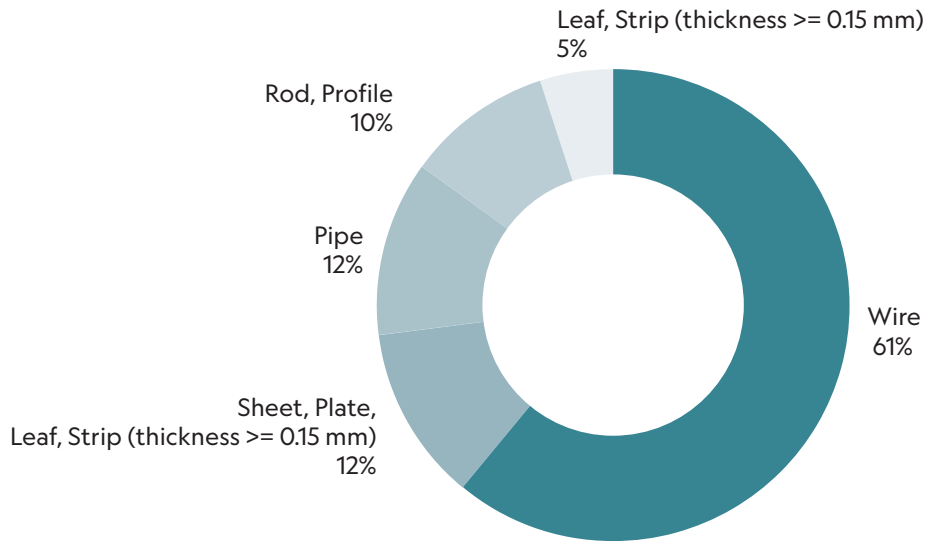




GLOBAL OUTLOOK OF THE SECTOR

Source: IWCC ve ICA (2021).

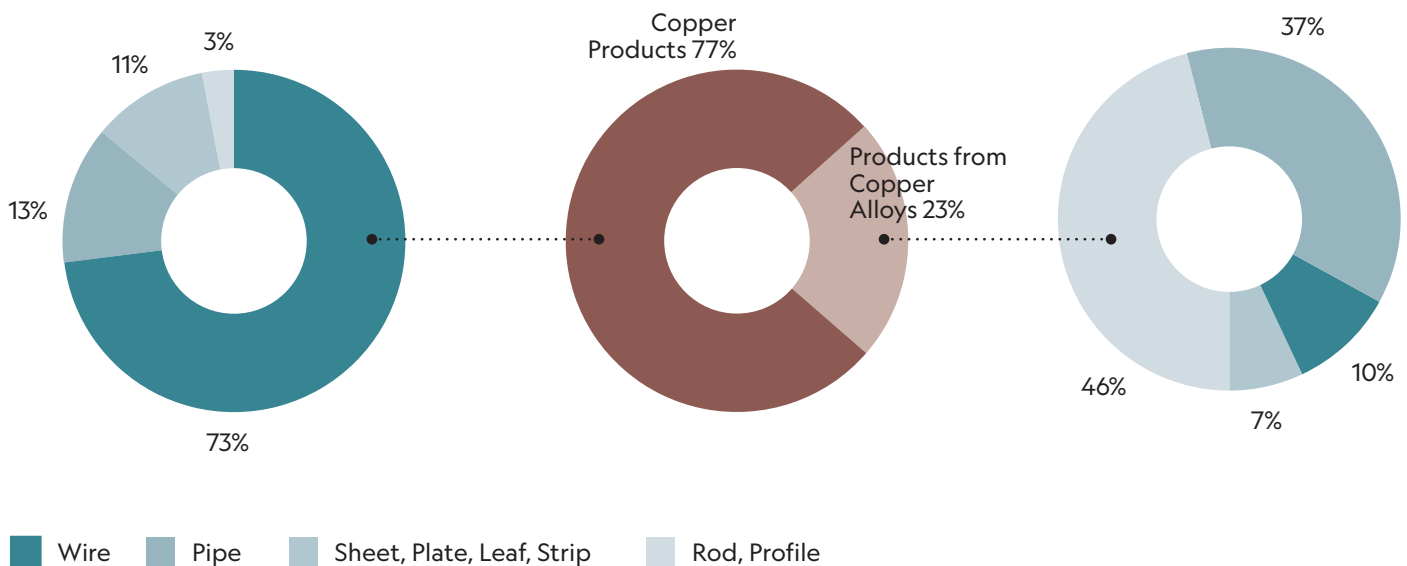
Figure 18: Distribution of Manufactured Products (%)



Global finished product production is approximately 28.5 million tons in 2020. 61% of the products produced are wire. While 77% of the products are produced from copper, 23% are produced from copper alloys. Wire constitutes 73% of the copper manufactured products. The main reason for this is that copper is a good conductor of heat and electricity. In goods produced from copper alloys, wire accounts for 10%.

Source: IWCC & ICA (2021).

Figure 19: Breakdown of Manufactured Products as Copper and Copper Alloys

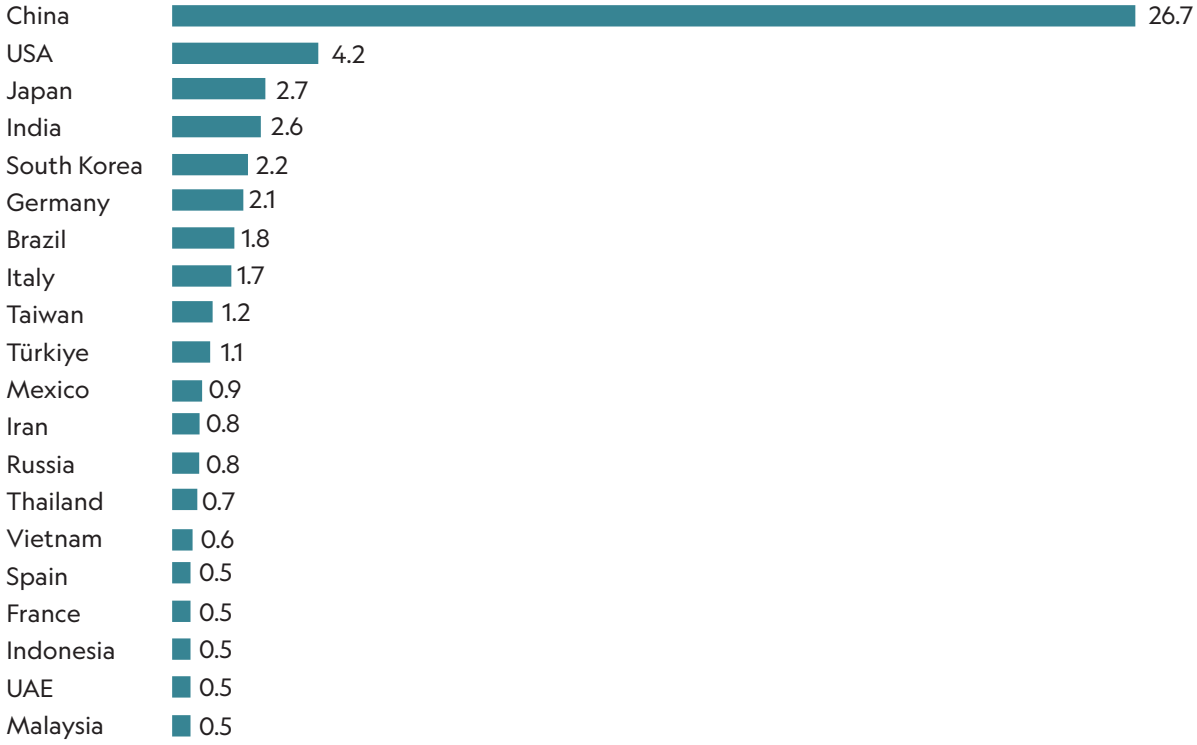


1.2.9. Global Product Manufacturing Capacity

China ranks first with a capacity of approximately 26.7 million tons. Türkiye, on the other hand, ranks 10th with a capacity of approximately 1.1 million tons.

Source: ICSG

Figure 20: Countries with the Highest Product Manufacturing Capacity (2020, Million Tons)

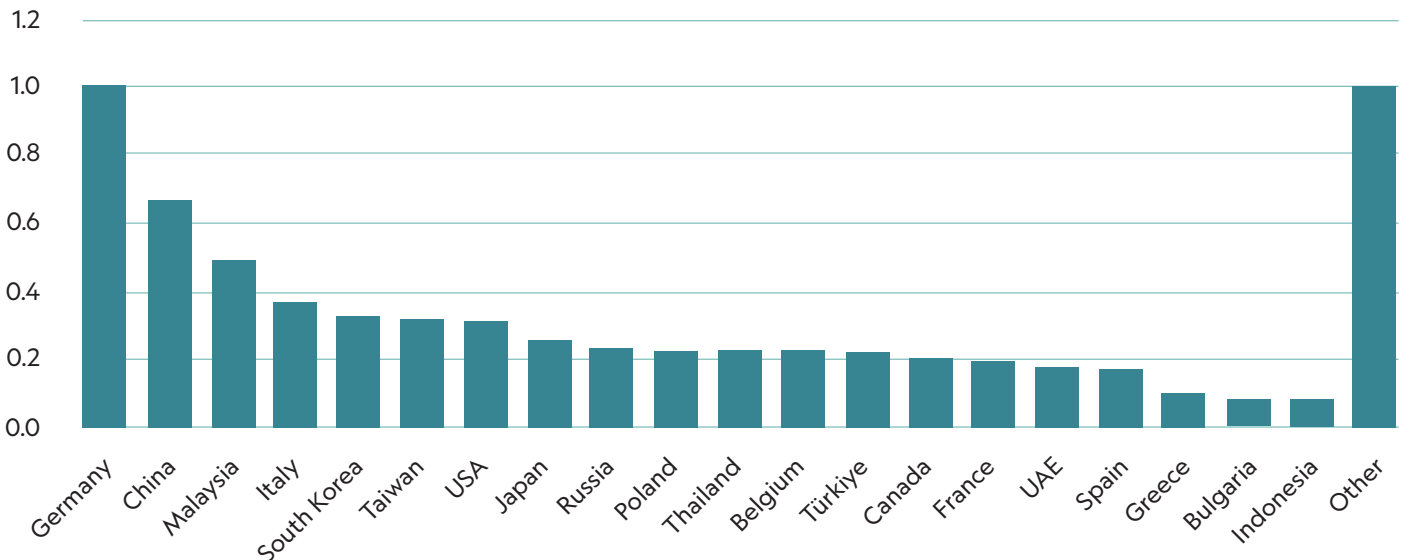


1.2.10. Global Manufactured Product Exports

Germany ranks 1st in manufactured product exports, followed by China in 2nd place.

Source: Trademap.

Figure 21: Major Manufactured Product Exporting Countries (Kilotons), 2021





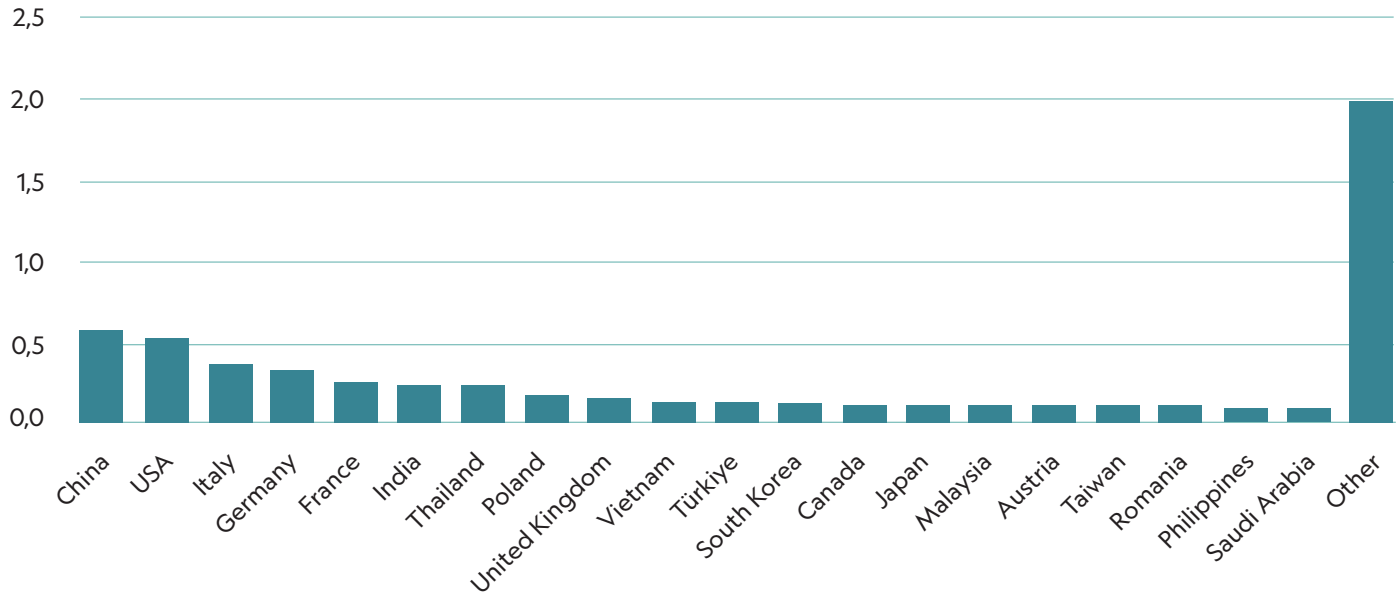
GLOBAL OUTLOOK OF THE SECTOR

1.2.11. Global Manufactured Product Imports

China ranks first in global manufactured product imports.

Source: Trademap.

Figure 22: Major Manufactured Product Importing Countries (Kilotons), 2021

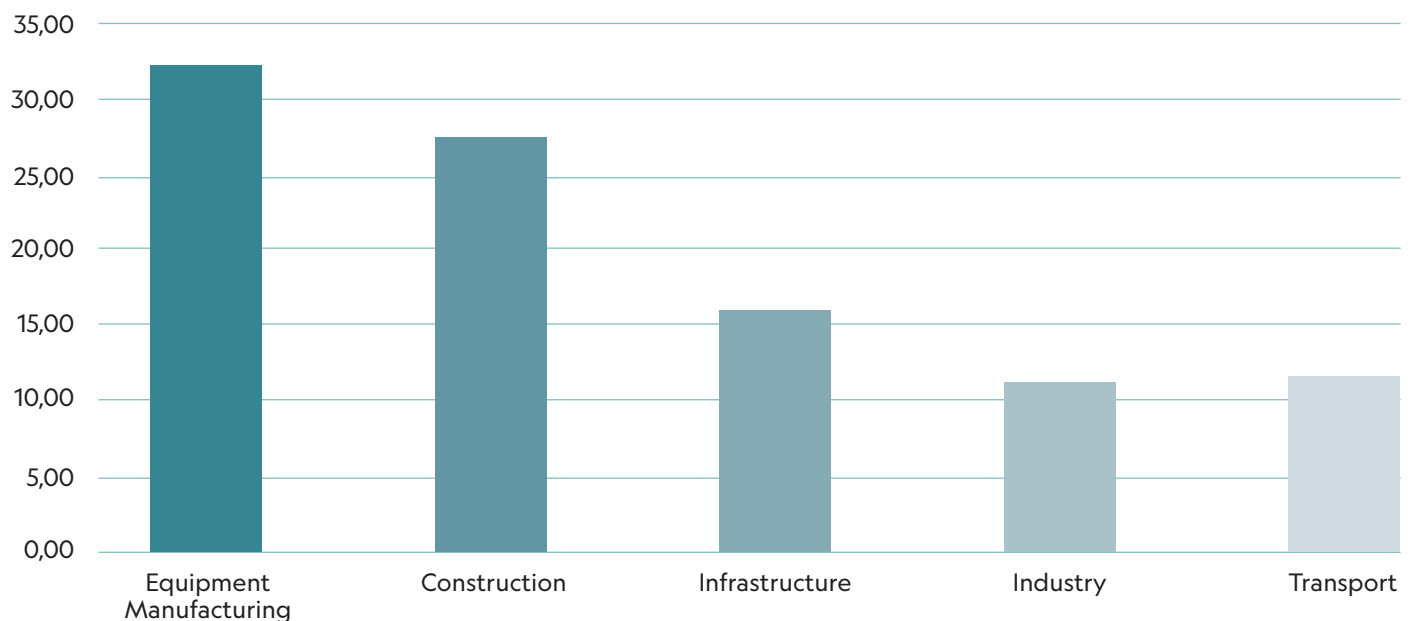


1.2.12. Distribution of the Sectors where the Manufactured Products are Used

The distribution of the sectors using manufactured products is shown in Figure 23.

Source: IWCC & ICA (2021).

Figure 23: Distribution of Sectors Using Manufactured Products, 2021



1.3. Technology, Business Models and Structural Changes

On the supply side, 207 million tons of copper were mined all over the world between 2010 and 2020. In the same period, reserves increased by 240 million tons and reached 870 million tons. This is a striking example of the impact of new technologies used in exploration and extraction activities on the sector. Technology plays a key role in meeting many challenges. The new technologies and production techniques being developed are extremely important for the consistent continuation of the global supply.

Recycling will also continue to be one of the important business models on the supply side. Today's primary copper is tomorrow's recycled copper. Unlike other

commodities such as energy or food, copper is not considered "consumed" even after it was used. Copper is one of the few raw materials that can be recycled and used over and over again without loss of performance due to its nature. Therefore, stakeholders such as policy makers, scrap collectors, copper producers should make recycling a common denominator of their business models.

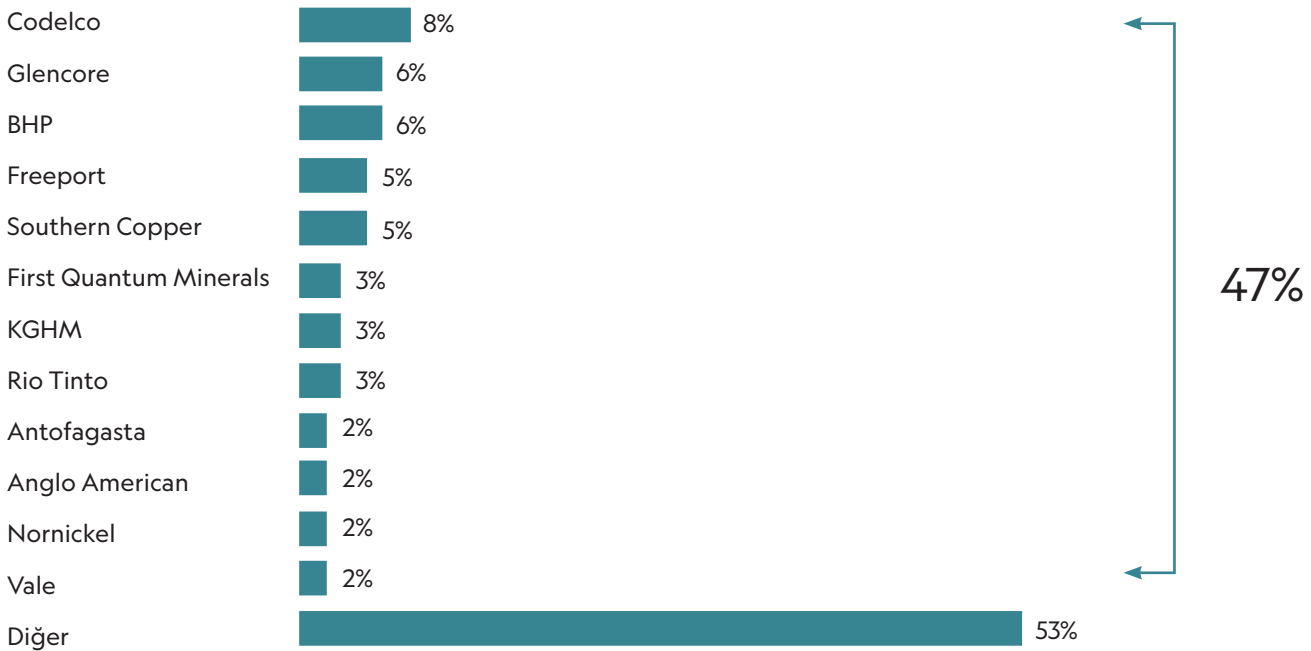
Deep Sea Mining, which has not been on the agenda until today, is emerging as an alternative that can protect the future copper supply. The oceans cover about 70% of the earth's surface and the ocean floor contains important mineral resources, including copper. Seafloor deposits, which will be crucial in meeting the growing demand for copper, should begin to be a business model for the future.

1.4. Global Competition

The largest copper ore producers in the world for 2020 and their market shares are given in Figure 24.

Source: Wood Mackenzie (2021).

Figure 24: Leading Players in Global Ore Production



It is seen that the largest ore producers create added value by processing the ore.



GLOBAL OUTLOOK OF THE SECTOR

Source: Annual reports of companies.

Table 8: Activities of Major Players in Ore Production

Companies	Miner	Smelter	Refinery
Codelco	•	•	•
Glencore	•	•	
BHP	•	•	•
Freeport	•	•	•
Southern Copper	•	•	•
First Quantum Minerals	•	•	
KGHM	•	•	•
Rio Tinto	•	•	•
Antofagasta	•		
Anglo American	•	•	
Nomickel	•	•	•
Vale	•		

Source: ICSG.

Table 9: Copper Usage Intensity, 2020

Countries	GDP per capita (in Dollars)	Intensity (Ton/Billion Dollars)
UAE	31,983	1,095.2
China	10,484	980.0
Vietnam	3,499	965.5
Zambia	981	769.7
Türkiye	8,548	632.4
Thailand	7,190	611.9
Taiwan	28,306	566.2
Malaysia	10,270	517.7
Poland	15,654	460.4
Belgium	44,531	438.6
South Korea	31,497	392.1
Mexico	8,421	330.3
Germany	45,733	275.0
Egypt	3,587	269.7
Spain	27,132	266.3
Saudi Arabia	20,178	243.2
Italy	31,288	233.4
Sweden	51,798	223.2
Russia	10,037	207.1
Iran	7,555	202.1
Brazil	6,783	195.0
Chile	12,990	182.8
Japan	40,146	166.0
India	1,965	151.4
Indonesia	3,922	150.1
Canada	43,278	88.3
USA	63,416	81.5
France	39,907	59.7
Australia	52,824	3.7

Figure 25: World's Top Capacity Refined Copper Production Facilities





GLOBAL OUTLOOK OF THE SECTOR

1.4.1. Major Global Manufactured Products Exporting and Importing Countries

Source: Trademap.

Table 10: Global Copper Products Trade, 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market Share (%)
Germany	1,001,699	14.4	China	576,642	9.3
China	671,344	9.6	USA	530,178	8.5
Malaysia	492,783	7.1	Italy	370,200	6.0
Italy	369,090	5.3	Germany	336,573	5.4
South Korea	329,692	4.7	France	253,379	4.1
Taiwan	319,210	4.6	India	232,146	3.7
USA	312,109	4.5	Thailand	231,714	3.7
Japan	255,409	3.7	Poland	174,018	2.8
Russia	236,827	3.4	United Kingdom	160,234	2.6
Poland	234,803	3.4	Vietnam	145,428	2.3
Thailand	230,025	3.3	Türkiye	143,086	2.3
Belgium	228,469	3.3	South Korea	132,787	2.1
Türkiye	221,393	3.2	Canada	131,265	2.1
Canada	208,416	3.0	Japan	122,937	2.0
France	198,121	2.8	Malaysia	119,803	1.9
UAE	183,328	2.6	Austria	116,489	1.9
Spain	180,430	2.6	Taiwan	116,105	1.9
Greece	100,142	1.4	Romania	113,961	1.8
Bulgaria	90,338	1.3	Philippines	110,101	1.8
Indonesia	89,908	1.3	Saudi Arabia	106,069	1.7
Other	1,003,843	14.4	Other	1,984,457	32.0
Total	6,957,379	100.0	Total	6,207,572	100.0

Table 11: Global Copper Rods and Profiles Trade, 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market Share (%)
Germany	165,005	18.3	Germany	84,682	11.0
Italy	129,301	14.4	China	75,457	9.8
Malaysia	66,218	7.4	Italy	66,510	8.6
France	58,014	6.4	USA	48,997	6.4
South Korea	54,517	6.1	United Kingdom	35,096	4.6
Thailand	40,750	4.5	France	31,721	4.1
USA	40,417	4.5	Spain	30,765	4.0
Japan	33,777	3.8	Canada	26,310	3.4
Taiwan	32,280	3.6	Poland	23,637	3.1
Poland	27,804	3.1	Czech Republic	21,208	2.8
Bulgaria	26,707	3.0	Denmark	19,001	2.5
Spain	21,492	2.4	Holland	17,803	2.3
Türkiye	17,640	2.0	Taiwan	17,441	2.3
China	15,126	1.7	Thailand	15,194	2.0
Belgium	15,097	1.7	Vietnam	14,768	1.9
Indonesia	13,452	1.5	India	14,733	1.9
Ukraine	13,142	1.5	Switzerland	14,268	1.9
Greece	12,829	1.4	Norway	13,119	1.7
Sweden	10,536	1.2	Türkiye	13,080	1.7
Peru	9,310	1.0	Austria	12,326	1.6
Other	96,338	10.7	Other	175,070	22.7
Total	899,752	100.0	Total	771,186	100.0



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Source: Trademap.

Table 12: Global Copper Wires Trade, 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market Share (%)
Germany	398,274	13.2	USA	238,325	8.9
Russia	220,389	7.3	Italy	158,574	5.9
Belgium	204,301	6.8	China	123,085	4.6
USA	194,644	6.4	India	114,000	4.3
Canada	187,586	6.2	Germany	110,716	4.1
Poland	177,733	5.9	Romania	96,557	3.6
UAE	174,271	5.8	Saudi Arabia	89,852	3.4
Türkiye	144,180	4.8	France	88,200	3.3
Spain	143,912	4.8	Türkiye	84,479	3.2
France	104,657	3.5	Vietnam	79,640	3.0
Malaysia	103,927	3.4	Poland	77,084	2.9
Thailand	92,441	3.1	Philippines	75,883	2.8
South Korea	91,124	3.0	Morocco	73,157	2.7
China	83,041	2.7	Thailand	69,592	2.6
Indonesia	73,839	2.4	Austria	67,242	2.5
Sweden	70,810	2.3	Canada	63,469	2.4
Italy	60,855	2.0	United Kingdom	62,814	2.3
Vietnam	58,907	2.0	Belgium	60,942	2.3
Peru	47,682	1.6	South Africa	58,493	2.2
Egypt	41,706	1.4	Kuwait	51,375	1.9
Other	345,454	11.4	Other	832,945	31.1
Total	3,019,733	100.0	Total	2,676,424	100.0

Table 13: Global Copper Sheets, Plates, Leaves and Strips (Thickness > 0.15 mm) Trade, 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market Share (%)
Germany	300,181	31.3	China	127,836	13.7
Japan	123,454	12.9	USA	80,922	8.7
China	80,434	8.4	Italy	80,118	8.6
South Korea	77,642	8.1	France	67,267	7.2
Bulgaria	52,955	5.5	Germany	55,017	5.9
Italy	51,607	5.4	Thailand	54,133	5.8
USA	32,460	3.4	Taiwan	39,404	4.2
Türkiye	29,066	3.0	Czech Republic	36,065	3.9
Hong Kong	28,463	3.0	Malaysia	35,822	3.8
Taiwan	25,875	2.7	Japan	32,954	3.5
Thailand	22,691	2.4	Hong Kong	31,303	3.4
Holland	21,881	2.3	Vietnam	24,414	2.6
France	17,480	1.8	Switzerland	23,227	2.5
Brazil	14,573	1.5	United Kingdom	20,417	2.2
United Kingdom	12,868	1.3	India	19,398	2.1
Serbia	12,629	1.3	South Korea	17,707	1.9
Peru	7,499	0.8	Holland	16,728	1.8
Malaysia	6,700	0.7	Indonesia	16,455	1.8
India	5,788	0.6	Philippines	15,183	1.6
Poland	5,646	0.6	Poland	14,630	1.6
Other	30,041	3.1	Other	121,594	13.1
Total	959,933	100.0	Total	930,594	100.0



GLOBAL OUTLOOK OF THE SECTOR

Source: Trademap.

Table 14: Global Copper Sheets and Strips (Thickness ≤ 0.15 mm) Trade, 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market Share (%)
Taiwan	217,153	36.2	China	217,453	38.5
China	132,282	22.1	South Korea	71,955	12.8
South Korea	53,858	9.0	Thailand	34,978	6.2
Japan	49,253	8.2	Japan	31,810	5.6
Hong Kong	34,871	5.8	Hong Kong	30,581	5.4
Malaysia	28,298	4.7	Taiwan	22,579	4.0
Holland	15,139	2.5	USA	18,223	3.2
Thailand	13,665	2.3	India	17,501	3.1
Germany	11,631	1.9	Vietnam	15,452	2.7
Luxembourg	10,824	1.8	Malaysia	14,994	2.7
Philippines	7,253	1.2	Poland	14,530	2.6
Italy	6,175	1.0	Germany	7,793	1.4
Türkiye	2,999	0.5	Holland	5,929	1.1
India	2,917	0.5	Egypt	4,503	0.8
Singapore	1,819	0.3	Canada	4,467	0.8
Austria	1,766	0.3	Indonesia	4,458	0.8
Canada	1,593	0.3	Singapore	3,763	0.7
Bulgaria	1,490	0.2	Philippines	3,295	0.6
Belgium	1,011	0.2	United Kingdom	2,761	0.5
Spain	788	0.1	Pakistan	2,688	0.5
Other	4,607	0.8	Other	34,517	6.1
Total	599,392	100.0	Total	564,230	100.0

Table 15: Global Copper Thin and Thick Pipe Trade, 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market Share (%)
China	357,060	31.9	USA	140,794	11.8
Germany	116,176	10.4	Germany	71,112	6.0
Italy	115,155	10.3	India	65,330	5.5
Greece	73,831	6.6	France	62,340	5.2
Thailand	60,131	5.4	Italy	58,410	4.9
South Korea	49,288	4.4	Thailand	54,556	4.6
Malaysia	42,836	3.8	Poland	43,798	3.7
USA	37,622	3.4	United Kingdom	38,085	3.2
Türkiye	26,567	2.4	Türkiye	32,030	2.7
Austria	26,435	2.4	Russia	30,845	2.6
Poland	23,041	2.1	Czech Republic	29,884	2.5
Canada	17,062	1.5	China	28,845	2.4
Uzbekistan	14,761	1.3	South Korea	27,731	2.3
France	12,961	1.2	Japan	27,663	2.3
India	11,547	1.0	Taiwan	26,296	2.2
Finland	10,686	1.0	Belgium	26,000	2.2
Spain	9,776	0.9	Malaysia	25,385	2.1
Holland	8,793	0.8	Holland	24,717	2.1
Japan	8,294	0.7	Canada	23,613	2.0
South Africa	7,318	0.7	Australia	23,159	1.9
Other	88,476	7.9	Other	334,325	28.0
Total	1,117,816	100.0	Total	1,194,919	100.0

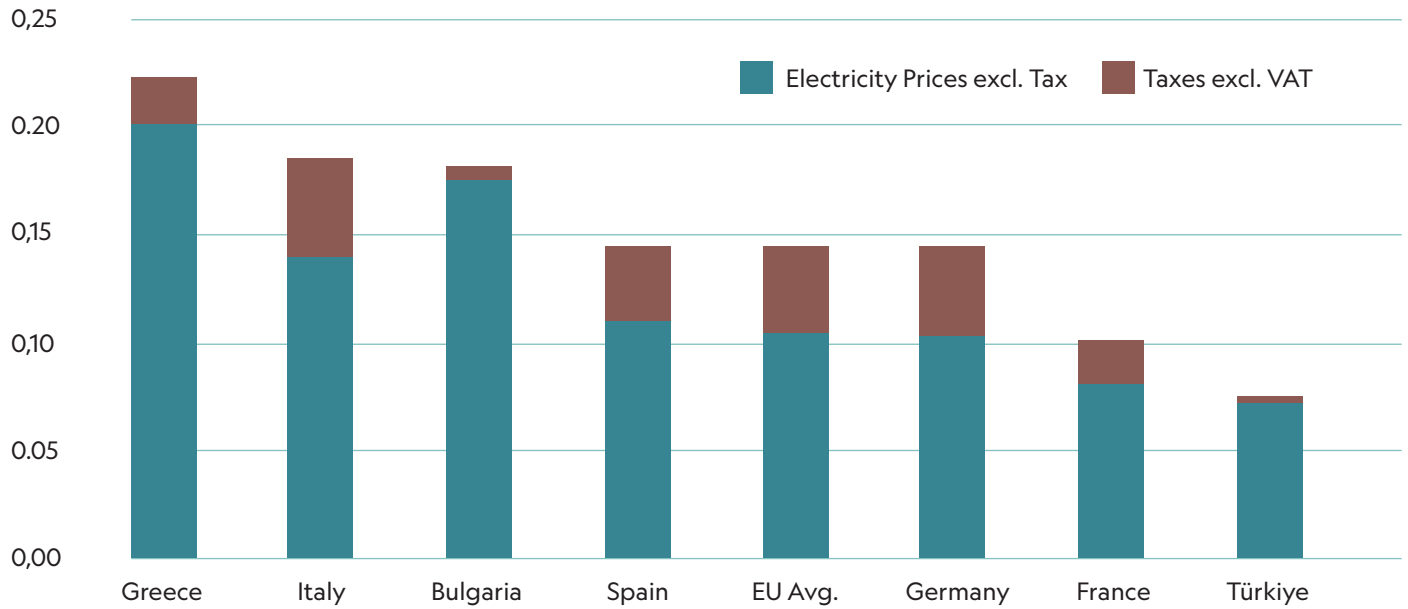


GLOBAL OUTLOOK OF THE SECTOR

1.4.2. Key Indicators

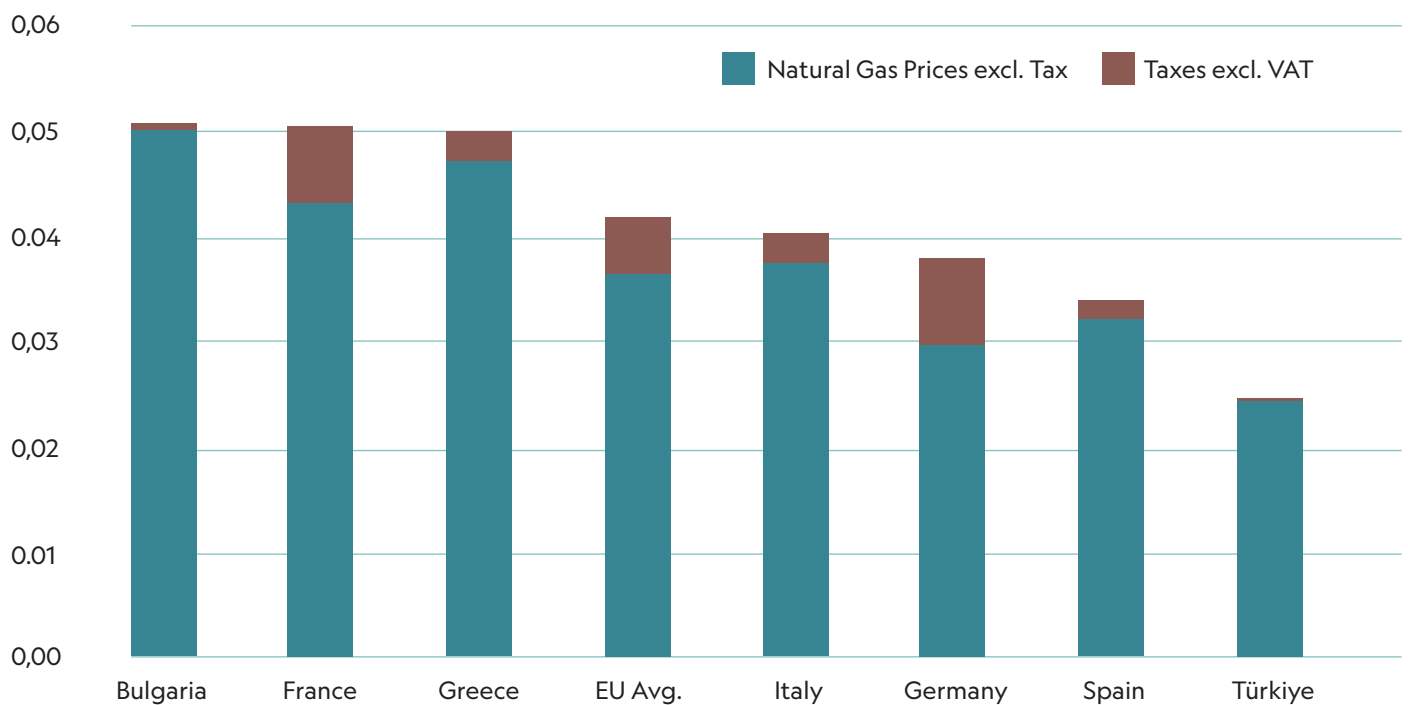
Source: Eurostat.

Figure 26: Electricity Prices for Non-Household Consumers in the Second Half of 2021 by Country (Euros per kWh)



Source: Eurostat.

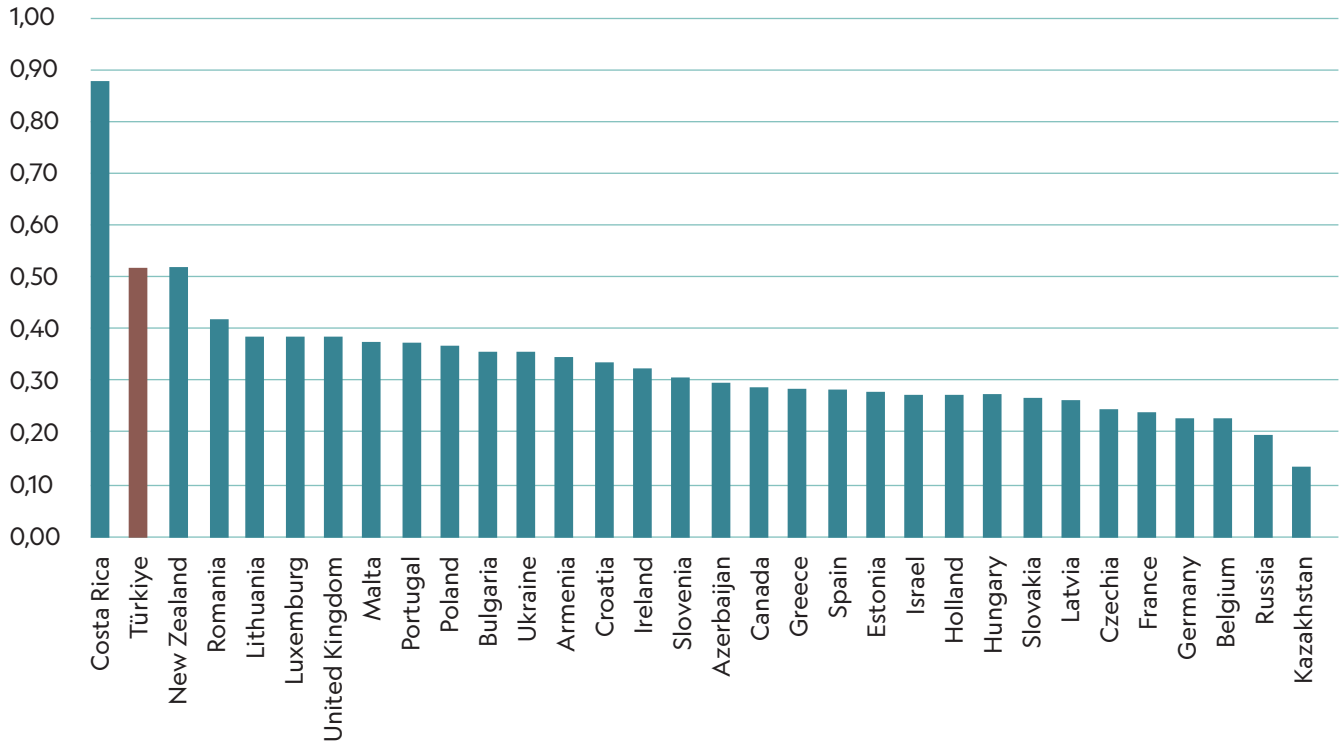
Figure 27: Natural Gas Prices for Non-Household Consumers in the Second Half of 2021 by Country (Euros per kWh)



Labor force and minimum wage data were obtained through ILOSTAT. The data were created by choosing the most up-to-date data of each country between the years 2020 and 2018. The 2017 purchasing power parity (PPP) based dollar is used as the currency.

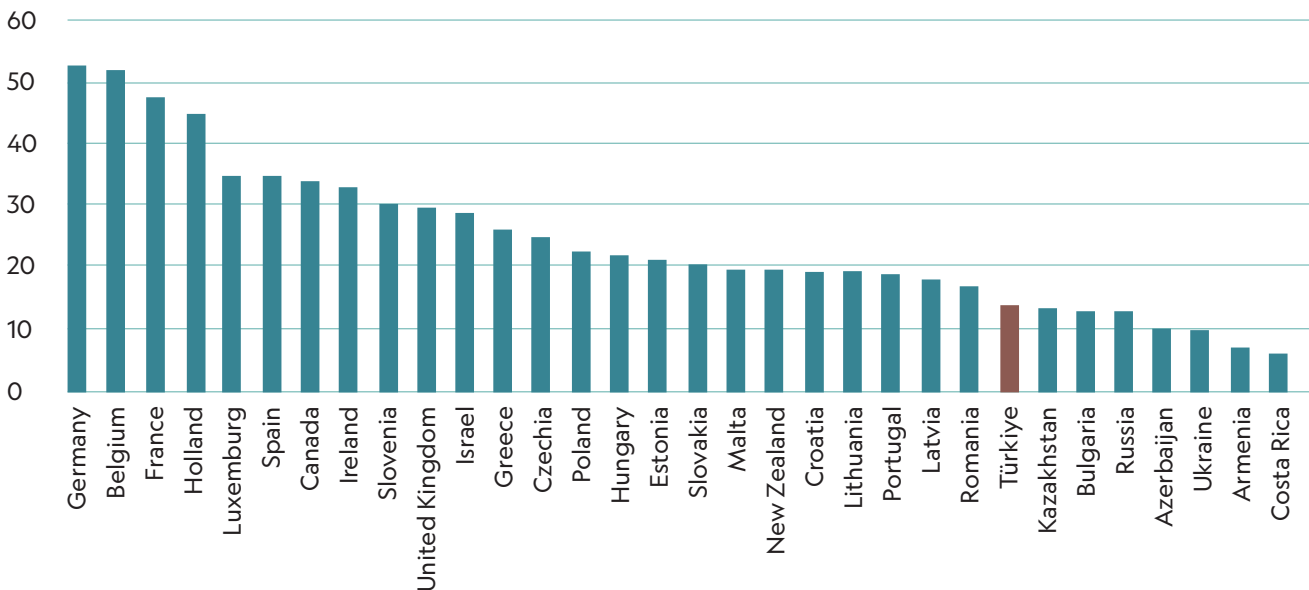
Source: ILOSTAT.

Figure 28: Ratio of Minimum Wage to Labor Cost (%), (The most recent data of countries, 2018-2020)



Source: ILOSTAT.

Figure 29: Hourly Labor Cost per Employee (2017 PPP Based Dollars), (The most recent data of countries, 2018-2020)





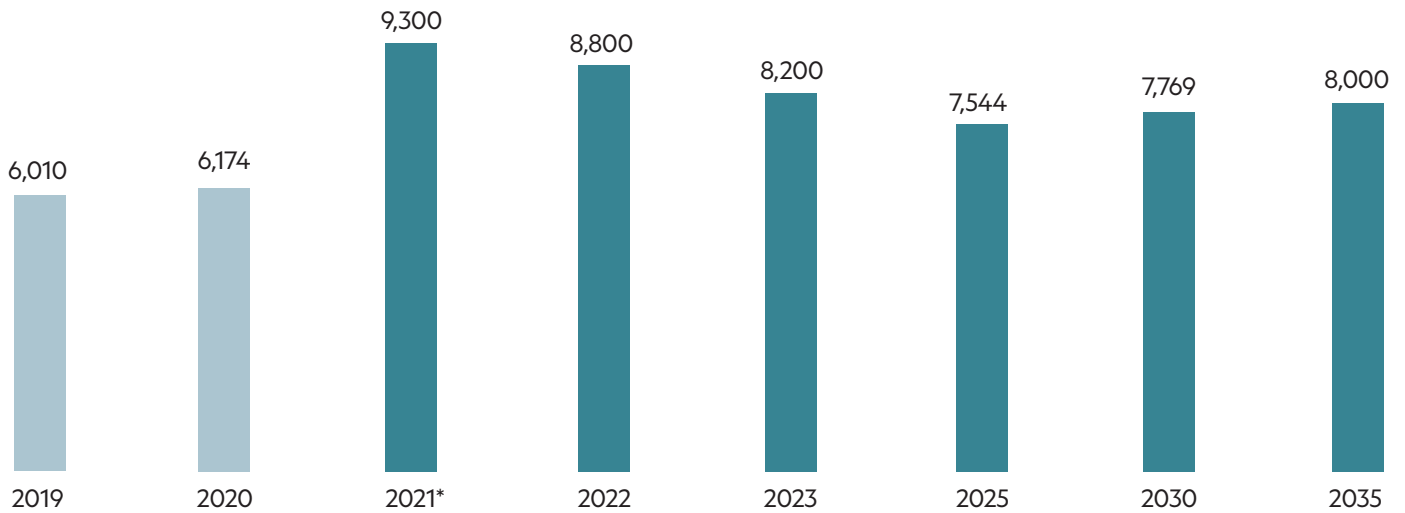
GLOBAL OUTLOOK OF THE SECTOR

1.5. Sectoral Forecasts

1.5.1. Copper Raw Material Price Forecast

Source: World Bank (2021).
* Includes estimated values for 2021 and later years.

Figure 30: Copper Raw Material Price Forecast (Dollars Per Ton)

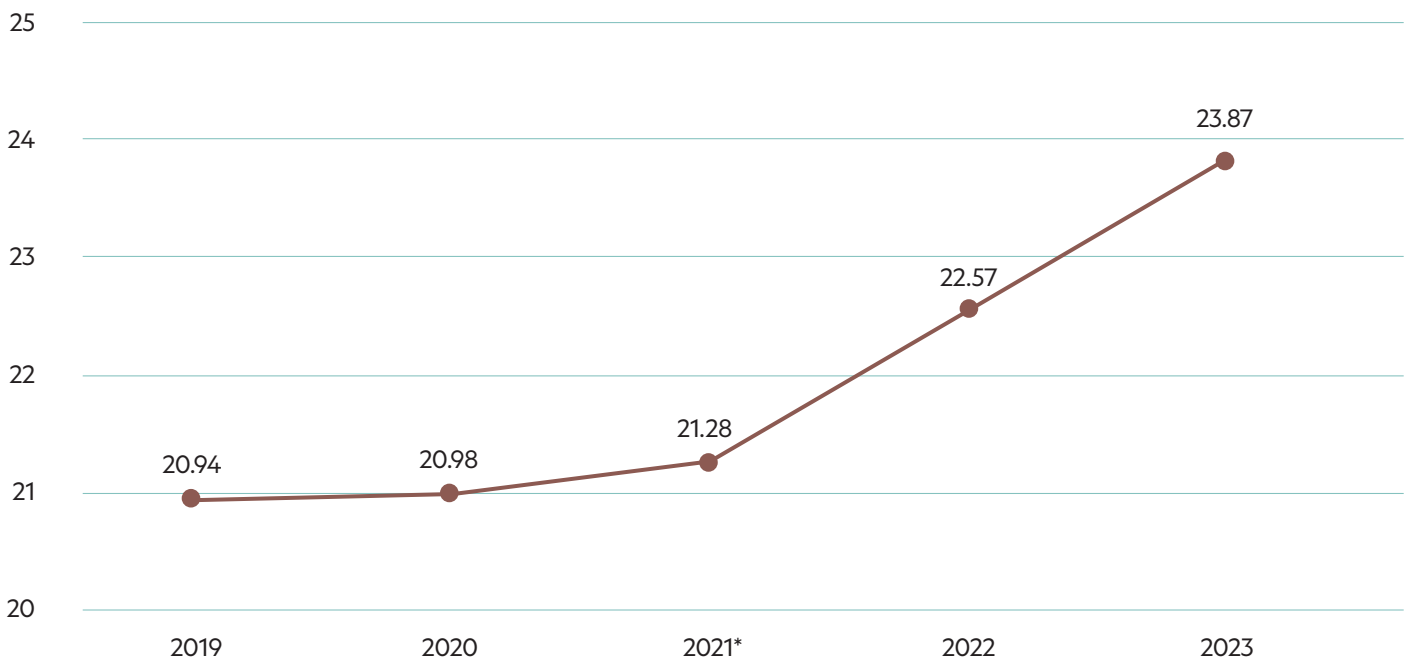


1.5.2. Copper Mine Production Amount Forecast

Copper mine production is expected to grow at an average annual rate of 5.9% in 2022 and 2023.

Source: Wood Mackenzie (2021).
* Includes estimated values for 2021 and later years.

Figure 31: Estimated Net Copper Produced by Global Mining (Million Tons)



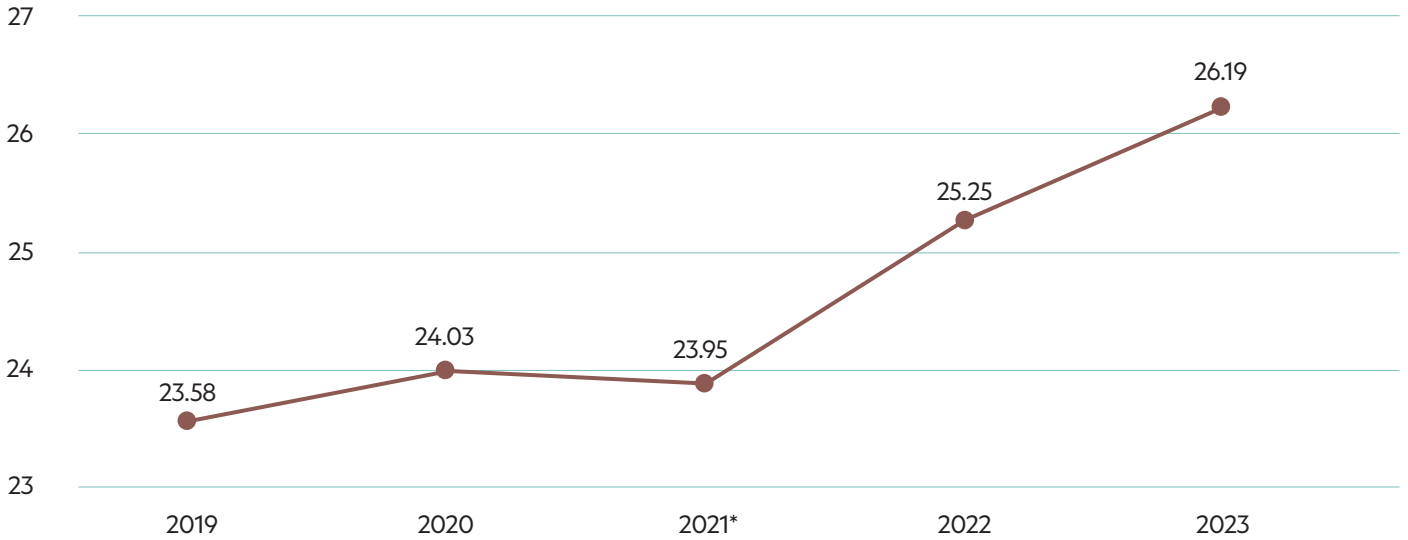
1.5.3. Refined Copper Production Forecast

Refined copper production is expected to grow at an average annual rate of 4.5% in 2022 and 2023.

Source: Wood Mackenzie (2021).

* Includes estimated values for 2021 and later years.

Figure 32: Global Refined Copper Production Forecast (Million Tons)



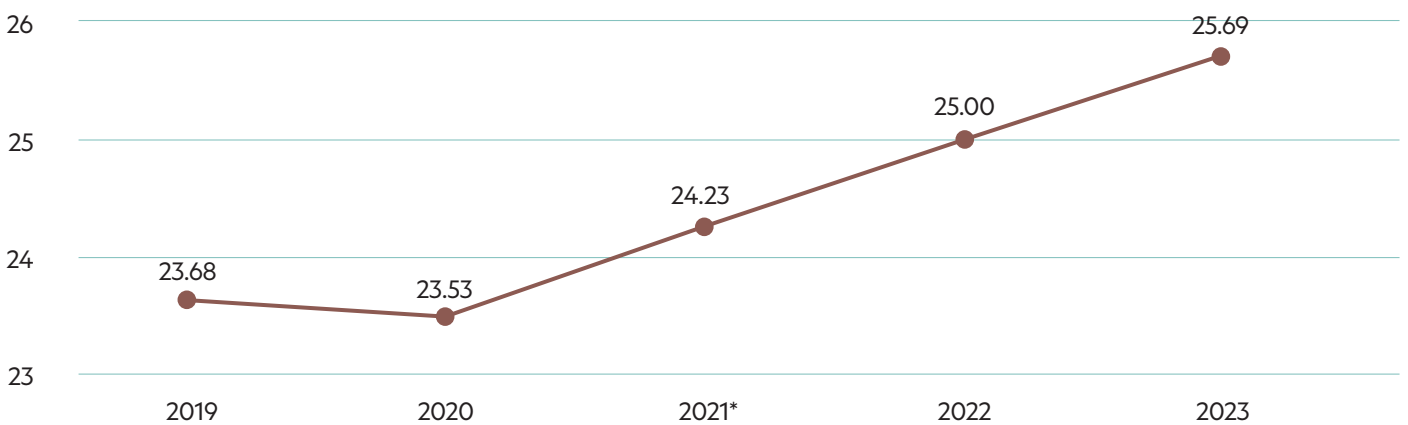
1.5.4. Refined Copper Consumption Forecast

Refined copper consumption is expected to grow at an average annual rate of 3% in 2022 and 2023.

Source: Wood Mackenzie (2021).

* Includes estimated values for 2021 and later years.

Figure 33: Global Refined Copper Consumption Forecast (Million Tons)



2.

PART:
OUTLOOK OF
THE SECTOR
IN TÜRKİYE

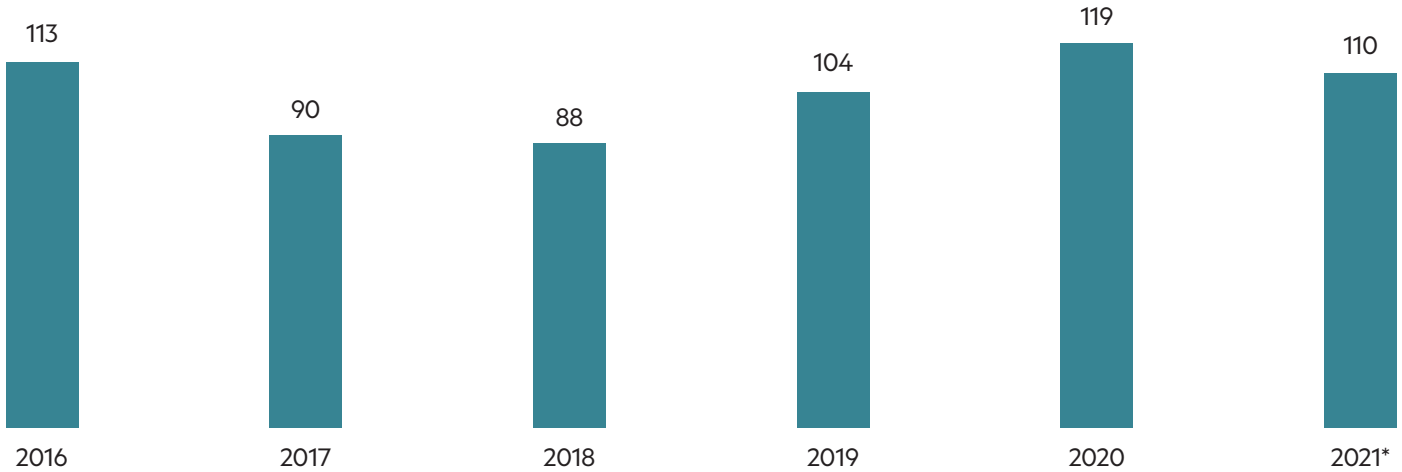
2.1. Production

2.1.1. Copper Mining Production of Türkiye

Türkiye's copper mine production is about 110-130 kilotons. According to the information received from sector representatives in Türkiye, approximately 8.5 million tons of raw copper was produced in 2020.

Source: Wood Mackenzie (2021).
*Includes estimated values.

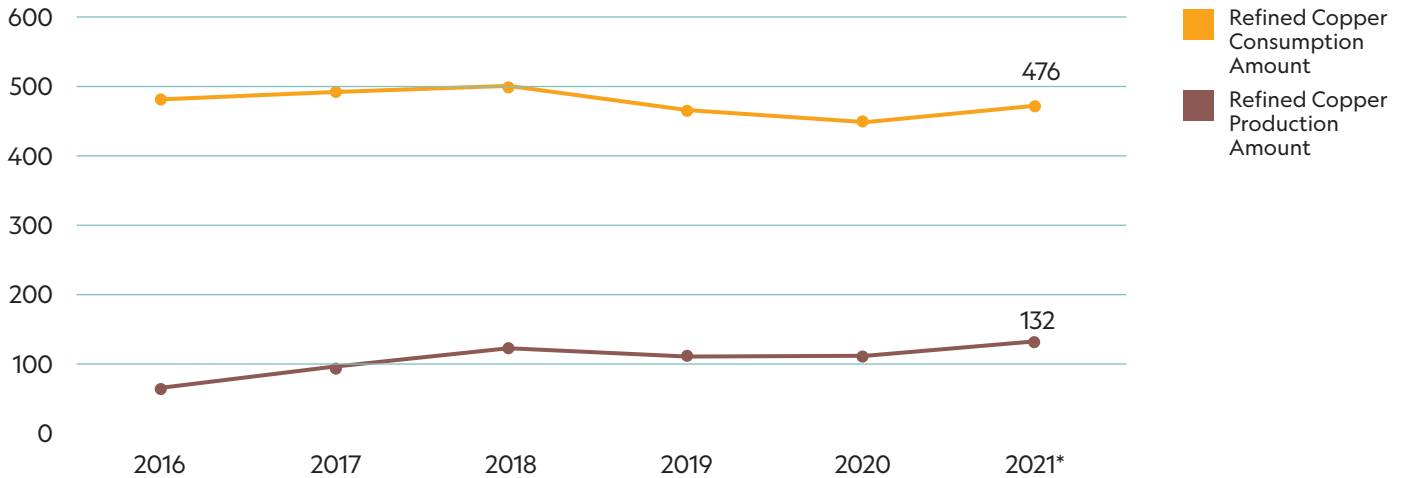
Figure 34: Net Copper Amount Produced by Turkish Mining (Kilotons)



2.1.2. Refined Copper Production and Consumption of Türkiye

Source: Wood Mackenzie (2021).
*Includes estimated values.

Figure 35: Refined Copper Production and Consumption Amounts in Türkiye (Kilotons)



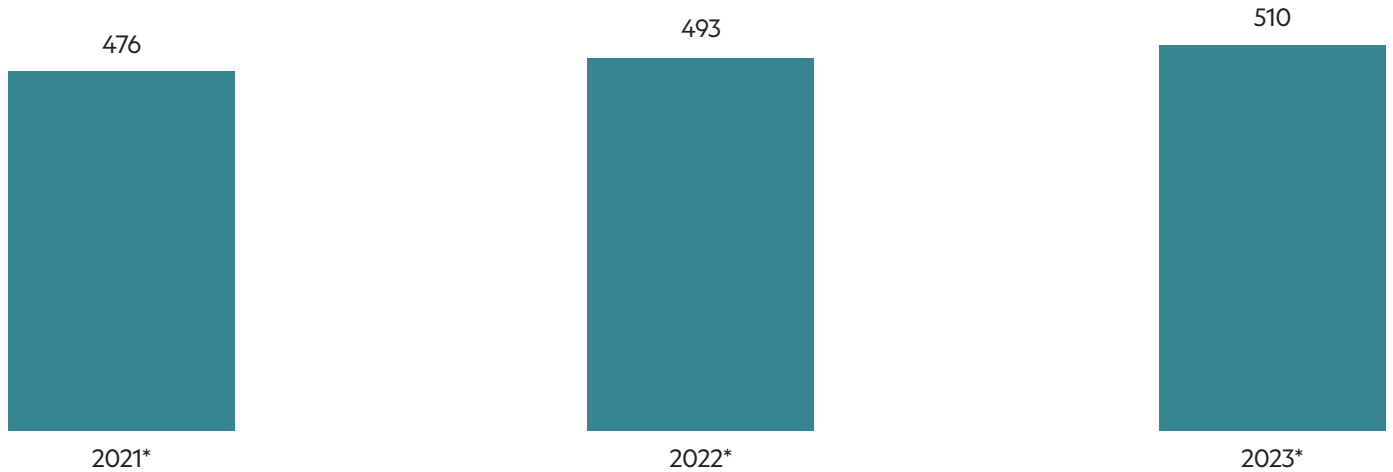


OUTLOOK OF THE SECTOR IN TÜRKİYE

It is expected that Türkiye's refined copper consumption will be above the global average with an average annual growth of 3.5% in 2022 and 2023.

Source: Wood Mackenzie (2021).
*Includes estimated values.

Figure 36: Refined Copper Consumption Expectation of Türkiye (Kilotons)

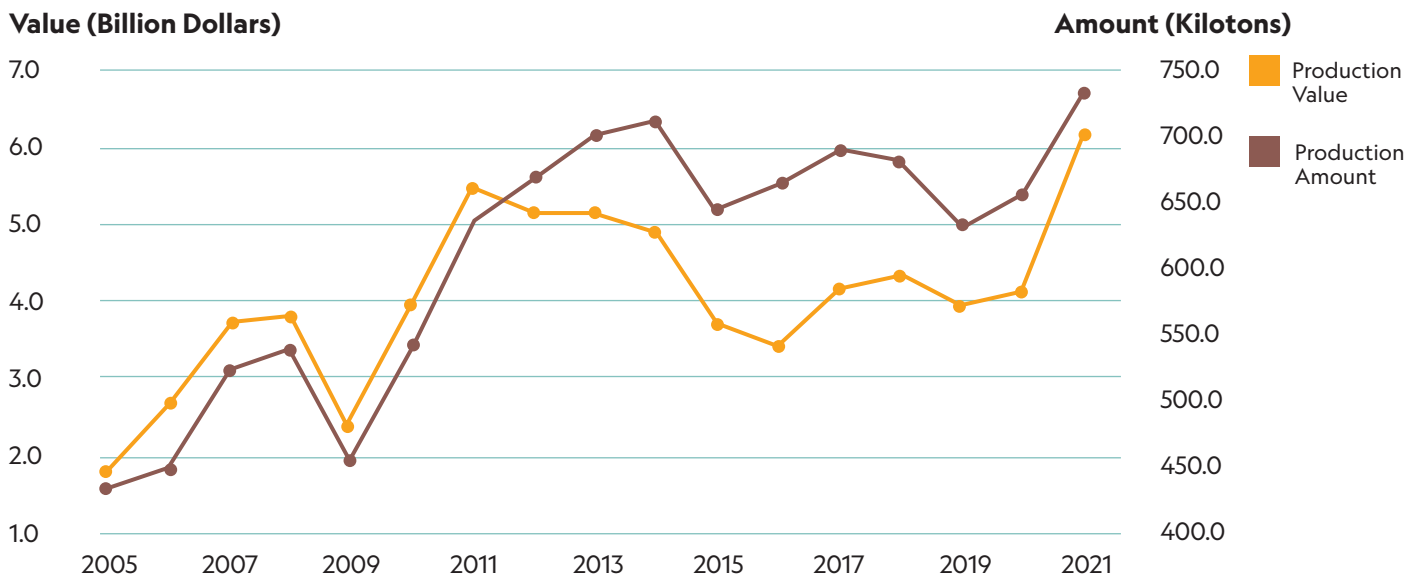


2.1.3. Product Manufacturing in Türkiye

According to TURKSTAT, the product manufacturing, which was 433 kilotons in 2005, increased to 732 kilotons in 2021. The production amount in 2021 corresponds to 54.8 billion TL or 6.1 billion dollars.

Source: TurkStat.

Figure 37: Manufactured Products Amount and Value in Türkiye



2.2. Foreign Trade

Looking at the whole sector, it is seen that there is a foreign trade deficit of 2.7 billion dollars in 2021. Its main reason is that the sector is foreign-dependent at the rate of 76% in terms of raw materials.

Source: Trademap.

Table 16: Turkish Copper and Copper Alloys Sector Export Figures

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Export Value (Million Dollars)	1,391	1,384	1,422	1,350	1,169	1,115	1,442	1,793	1,525	1,581	2,600
Export Amount (Kilotons)	150	163	179	175	179	192	211	247	219	229	267

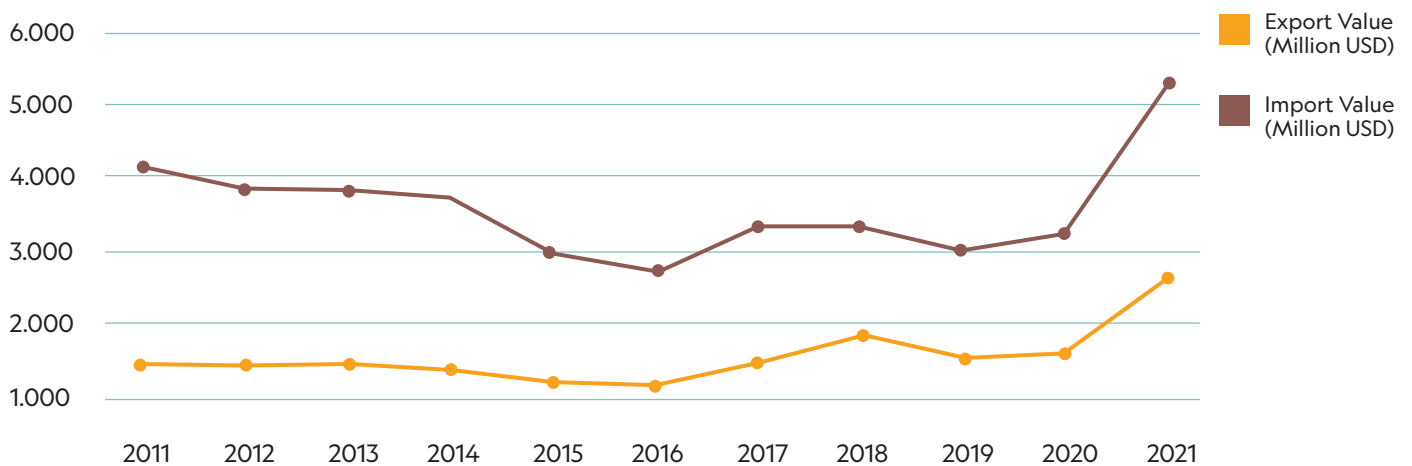
Source: Trademap.

Table 17: Turkish Copper and Copper Alloys Sector Import Figures

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Import Value (Million Dollars)	4,119	3,878	3,824	3,704	2,985	2,724	3,327	3,344	3,033	3,212	5,266
Import Amount (Kilotons)	448	471	499	516	511	533	521	490	486	512	573

Source: Trademap.

Figure 38: Turkish Foreign Trade





OUTLOOK OF THE SECTOR IN TÜRKİYE

Source: Trademap.

Table 18: Export Figures of the Sector on the Basis of HS Code, 2021

No	HS Code	Export Value (Million Dollars)	%	% (Cumulative Total)	HS Description
1	7408	814.31	31.32	31.32	Copper wires
2	7413	639.17	24.58	55.91	Wires, cables, braided ropes and such (other than electrically insulated) of copper
3	7403	272.02	10.46	66.37	Refined copper and copper alloys (crude)
4	7409	266.79	10.26	76.63	Copper Sheets, plates, leaves and strip, of a thickness exceeding 0.15 mm.
5	7412	227.81	8.76	85.39	Thin and thick copper pipe fittings (such as unions, elbows, sleeves)
6	7407	131.78	5.07	90.46	Copper bars and profiles
7	7411	94.61	3.64	94.10	Thin and thick copper pipes
8	7419	83.71	3.22	97.32	Other copper products
9	7410	29.44	1.13	98.45	Thin copper leaves and strips (thickness <= 0.15 mm)
10	7404	17.51	0.67	99.13	Copper waste and scrap
11	7406	8.25	0.32	99.44	Copper powders and copper flakes
12	7418	7.71	0.30	99.74	Table, kitchen and other household goods, health-protective articles and parts thereof, made of copper; sponges, cleaning and polishing articles, gloves and the such, of copper
13	7415	6.03	0.23	99.97	Small and large nails, tacks, threaded nails and such, of copper or heads of copper and bodies of iron and steel (other than those of heading 83.05); copper bolts and nuts, hook screws, rivets, pins, wedges, washers (including springing washer) and similar goods
14	7402	0.60	0.02	99.99	Unrefined copper; copper anodes for electrolytic refining
15	7405	0.08	0.00	100.00	Pre-alloys of copper (cupro alloys)
16	7401	0.06	0.00	100.00	Copper mattes; precipitated copper (sterip copper)
Total		2,599.87	100.00		

Table 19: Import Figures of the Sector on the Basis of HS Code, 2021

No	HS Code	Import Value (Million Dollars)	%	% (Cumulative Total)	HS Description
1	7403	3,391.35	64.41	64.41	Refined copper and copper alloys (crude)
2	7408	778.54	14.79	79.19	Copper wires
3	7404	431.54	8.20	87.39	Copper waste and scrap
4	7411	299.74	5.69	93.08	Thin and thick copper pipes
5	7409	104.41	1.98	95.06	Copper sheets, plates, leaves and strip (of a thickness exceeding 0.15 mm)
6	7407	97.83	1.86	96.92	Copper rods and profiles
7	7412	46.52	0.88	97.80	Thin and thick copper pipe fittings (such as unions, elbows, sleeves)
8	7419	34.55	0.66	98.46	Other copper products
9	7410	21.43	0.41	98.87	Thin copper leaves and strips (thickness <= 0.15 mm.)
10	7413	16.47	0.31	99.18	Copper wires, cables, braided ropes and such (other than electrically insulated)
11	7415	16.15	0.31	99.49	Small and large nails, tacks, threaded nails and such, of copper or heads of copper and bodies of iron and steel (other than those of heading 83.05); copper bolts and nuts, hook screws, rivets, pins, wedges, washers (including springing washer) and similar goods
12	7406	8.66	0.16	99.65	Copper powders and copper flakes
13	7405	8.08	0.15	99.80	Pre-alloys of copper (cupro alloys)
14	7418	5.04	0.10	99.90	Table, kitchen and other household goods, health-protective articles and parts thereof, made of copper; sponges, cleaning and polishing articles, gloves and the such, of copper
15	7402	2.66	0.05	99.95	Unrefined copper; copper anodes for electrolytic refining
16	7401	2.63	0.05	100.00	Copper mattes; precipitated copper (precipitated copper)
Total		5,265.60	100.00		



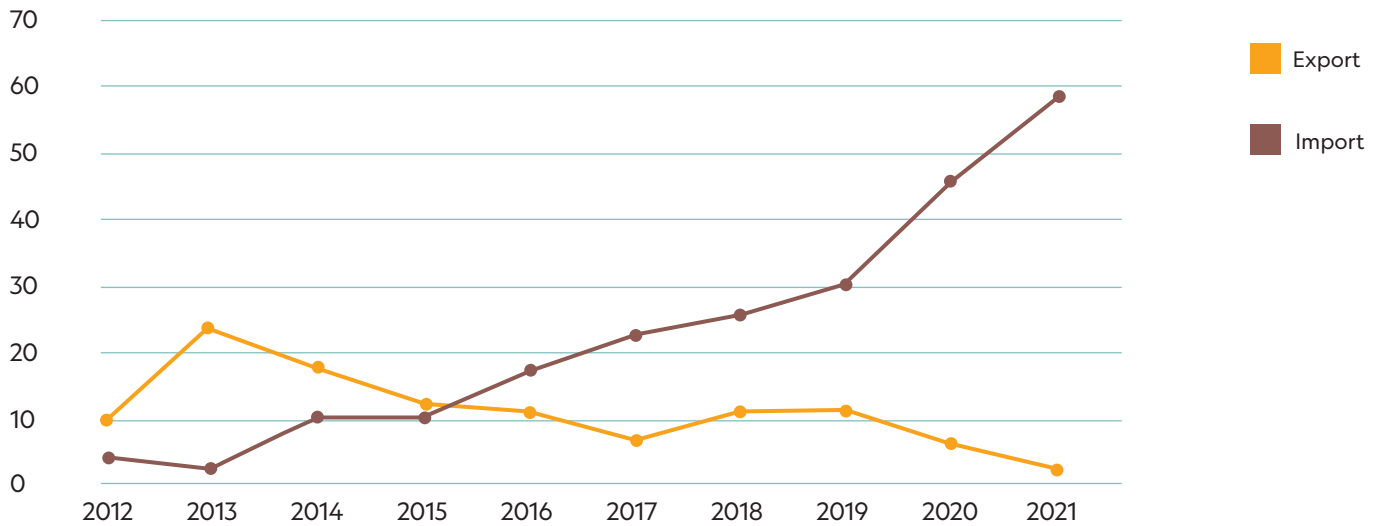
OUTLOOK OF THE SECTOR IN TÜRKİYE

2.2.1. Foreign Trade of Copper Scrap

Looking at the foreign trade of copper scrap, it is seen that imports of scrap increased, while exports decreased.

Source: Trademap.

Figure 39: Turkish Scrap Copper Foreign Trade Amount (Kiloton)



Türkiye makes 74% of its scrap exports to Bulgaria. 33% of scrap imports are made from Libya. Keeping Türkiye's scrap in the country and making importing procedure easier will bring the copper and copper alloys industry to a more advantageous position against its global competitors.

Source: Trademap.

Table 20: Türkiye's Scrap Exports by Country, 2021

Country of Export	Export Amount (Ton)	Market share (%)	Cumulative Total (%)
Bulgaria	1,743	73.54	73.54
China	194	8.19	81.73
Belgium	189	7.97	89.70
Spain	137	5.78	95.49
United Kingdom	42	1.77	97.26
Holland	30	1.27	98.52
Russia	23	0.97	99.49
Germany	9	0.38	99.87
Greece	3	0.13	100.00
Total	2,370	100	

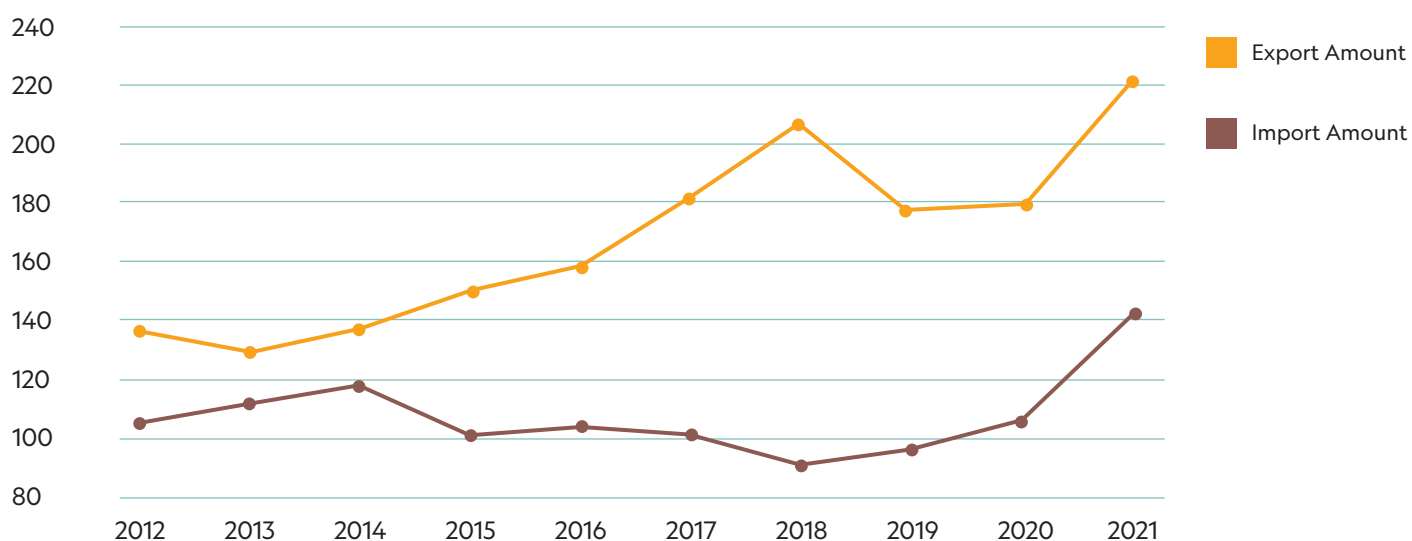
Table 21: Türkiye's Top 10 Scrap Import Countries, 2021

Country of Import	Import Amount (Ton)	Market share (%)	Cumulative Total (%)
Libya	19,726	33.4	33.4
Iran	14,071	23.8	57.2
Bulgaria	3,709	6.3	63.5
Romania	2,190	3.7	67.2
USA	1,586	2.7	69.9
Israel	1,449	2.5	72.4
Bosnia and Herzegovina	1,142	1.9	74.3
Albania	1,062	1.8	76.1
Norway	926	1.6	77.7
Germany	913	1.6	79.2
Other	12,279	20.8	100.0
Total	59,053	100,00	

2.2.2. Foreign Trade of Manufactured Products

Looking at the foreign trade of manufactured products in 2021, 2.2 billion dollars of products were exported. It is seen that the sector has a foreign trade deficit of approximately 839 million dollars in 2021.

Source: Trademap.

Figure 40: Amount of Manufactured Product Export and Import of Türkiye (Kilotons)



OUTLOOK OF THE SECTOR IN TÜRKİYE

Source: Trademap.

Table 22: Türkiye's Foreign Trade in Manufactured Product, 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market share (%)
Italy	36,807	16.6	Uzbekistan	34,935	24.4
Bulgaria	22,654	10.2	Russia	25,082	17.5
Germany	22,028	9.9	Iran	17,063	11.9
United Kingdom	15,438	7.0	France	9,385	6.6
Israel	13,731	6.2	Germany	9,235	6.5
France	11,367	5.1	China	8,974	6.3
USA	9,241	4.2	Egypt	8,028	5.6
Poland	8,617	3.9	Italy	5,643	3.9
Slovakia	6,214	2.8	Greece	4,718	3.3
Romania	4,465	2.0	Bulgaria	3,694	2.6
Czech Republic	4,397	2.0	Malaysia	2,730	1.9
Austria	4,263	1.9	Spain	2,489	1.7
Spain	4,183	1.9	Thailand	1,755	1.2
Hungary	3,942	1.8	South Korea	1,727	1.2
Egypt	3,559	1.6	Belgium	1,508	1.1
Ireland	3,321	1.5	Iraq	1,432	1.0
Bosnia and Herzegovina	3,034	1.4	Japan	835	0.6
Russia	2,600	1.2	Poland	786	0.5
Moldova	2,564	1.2	Holland	488	0.3
Serbia	2,224	1.0	USA	355	0.2
Other	36,746	16.6	Other	2,227	1.6
Total	221,395	100,0	Total	143,089	100,0

Table 23: Türkiye's Foreign Trade in Copper Rods and Profiles, 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market share (%)
Bulgaria	4,703	26.7	Uzbekistan	3,142	24.0
Italy	3,286	18.6	Italy	2,710	20.7
Germany	3,010	17.1	Iran	1,955	14.9
Czech Republic	906	5.1	Greece	947	7.2
Israel	488	2.8	France	922	7.0
Turkmenistan	458	2.6	Bulgaria	787	6.0
Finland	407	2.3	Poland	717	5.5
China	403	2.3	Japan	620	4.7
Spain	399	2.3	Germany	351	2.7
Egypt	376	2.1	Indonesia	330	2.5
Serbia	371	2.1	USA	155	1.2
Poland	333	1.9	Ukraine	118	0.9
Hong Kong	308	1.7	Czech Republic	74	0.6
Morocco	217	1.2	China	71	0.5
USA	206	1.2	Russia	44	0.3
Romania	203	1.2	Egypt	27	0.2
Sweden	178	1.0	Azerbaijan	24	0.2
France	152	0.9	South Korea	19	0.1
Greece	135	0.8	Iraq	19	0.1
Denmark	121	0.7	Belgium	18	0.1
Other	978	5.5	Other	31	0.2
Total	17,638	100,0	Total	13,081	100,0



OUTLOOK OF THE SECTOR IN TÜRKİYE

Source: Trademap.

Table 24: Türkiye's Foreign Trade in Copper Wires, 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market share (%)
Italy	22,794	15.8	Russia	25,032	29.6
Bulgaria	16,209	11.2	Uzbekistan	23,782	28.2
United Kingdom	13,893	9.6	Iran	10,643	12.6
Israel	12,169	8.4	France	8,243	9.8
Germany	9,947	6.9	Egypt	8,001	9.5
USA	7,986	5.5	Spain	2,421	2.9
France	7,573	5.3	Belgium	1,465	1.7
Poland	6,801	4.7	Iraq	1,321	1.6
Slovakia	5,796	4.0	China	1,156	1.4
Austria	4,023	2.8	Bulgaria	564	0.7
Romania	3,693	2.6	South Korea	452	0.5
Ireland	3,255	2.3	Germany	272	0.3
Hungary	2,803	1.9	Vietnam	251	0.3
Czech Republic	2,677	1.9	Italy	168	0.2
Moldavia	2,533	1.8	USA	141	0.2
Spain	2,462	1.7	India	132	0.2
South Africa	1,751	1.2	Austria	83	0.1
India	1,456	1.0	Japan	78	0.1
Slovenia	1,347	0.9	Slovakia	43	0.1
Norway	1,323	0.9	Hungary	40	0.0
Other	13,696	9.5	Other	187	0.2
Total	144,187	100.0	Total	84,475	100.0

Table 25: Türkiye's Foreign Trade in Copper Sheets, Plates, Leaves and Strips (Thickness > 0.15 mm), 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market share (%)
Italy	7,681	26.4	Germany	5,746	55.0
Germany	4,177	14.4	Bulgaria	2,256	21.6
Bosnia and Herzegovina	3,016	10.4	Uzbekistan	1,083	10.4
France	2,907	10.0	Iran	464	4.4
Egypt	1,552	5.3	South Korea	237	2.3
Colombia	1,306	4.5	China	232	2.2
United Kingdom	1,276	4.4	France	111	1.1
Lebanon	661	2.3	Iraq	92	0.9
Philippines	614	2.1	Holland	45	0.4
Algeria	563	1.9	Peru	35	0.3
Israel	387	1.3	Italy	35	0.3
USA	363	1.2	USA	31	0.3
Poland	360	1.2	Brazil	24	0.2
Spain	338	1.2	Malaysia	15	0.1
Morocco	316	1.1	Finland	13	0.1
Oman	303	1.0	Japan	11	0.1
Iraq	297	1.0	Spain	7	0.1
Bulgaria	275	0.9	India	7	0.1
Switzerland	249	0.9	United Kingdom	3	0.0
Kenya	198	0.7	Denmark	2	0.0
Other	2,228	7.7	Other	4	0.0
Total	29,067	100.0	Total	10,453	100.0



OUTLOOK OF THE SECTOR IN TÜRKİYE

Source: Trademap.

Table 26: Türkiye's Foreign Trade in Copper and Copper Alloys Thin Sheets and Strips (Thickness ≤ 0.15 mm), 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market share (%)
Egypt	1,388	46.3	China	1,573	66.0
Pakistan	408	13.6	Holland	416	17.5
Portugal	129	4.3	Thailand	120	5.0
Italy	107	3.6	Bulgaria	86	3.6
Greece	105	3.5	Taiwan	56	2.4
Spain	103	3.4	Germany	32	1.3
Lebanon	85	2.8	Italy	25	1.0
UAE	56	1.9	Uzbekistan	20	0.8
Ukraine	51	1.7	United Kingdom	16	0.7
Romania	50	1.7	South Korea	16	0.7
Jordan	49	1.6	USA	14	0.6
Germany	48	1.6	Belgium	4	0.2
Ireland	46	1.5	Luxembourg	2	0.1
Poland	41	1.4	Russia	1	0.0
Croatia	30	1.0	France	1	0.0
United Kingdom	29	1.0			
France	27	0.9			
Azerbaijan	24	0.8			
Argentina	23	0.8			
Algeria	23	0.8			
Other	178	5.9			
Total	3,000	100.0	Total	2,382	100.0

Table 27: Türkiye's Foreign Trade in Thin and Thick Pipes from Copper and Copper Alloys, 2021

Exporting Country	Amount (Ton)	Market share (%)	Importing Country	Amount (Ton)	Market share (%)
Germany	4,841	18.2	Uzbekistan	6,908	21.6
Italy	2,939	11.1	China	5,933	18.5
Russia	2,510	9.4	Iran	4,001	12.5
Bulgaria	1,146	4.3	Greece	3,771	11.8
Poland	1,082	4.1	Germany	2,727	8.5
Sweden	923	3.5	Malaysia	2,715	8.5
Hungary	909	3.4	Italy	2,534	7.9
Spain	881	3.3	Thailand	1,635	5.1
Czech Republic	708	2.7	South Korea	1,003	3.1
France	708	2.7	Austria	158	0.5
Norway	698	2.6	Finland	127	0.4
USA	675	2.5	Japan	126	0.4
Denmark	669	2.5	Spain	58	0.2
Israel	665	2.5	France	56	0.2
Serbia	599	2.3	India	51	0.2
Iraq	504	1.9	Poland	39	0.1
Thailand	427	1.6	Ukraine	37	0.1
Romania	411	1.5	Czech Republic	22	0.1
Holland	390	1.5	Portugal	19	0.1
Slovenia	364	1.4	Vietnam	14	0.0
Other	4,512	17.0	Other	96	0.3
Total	26,561	100.0	Total	32,030	100.0



OUTLOOK OF THE SECTOR IN TÜRKİYE

3 milyar dolar

The copper sector supplies approximately 3 billion dollars of products to the country.

2.2.3. Contribution to Current Balance

Since the mineral resources and processing plants in Türkiye are not sufficient, the copper sector is dependent on foreign sources as raw materials. The sector is running a current account deficit as it outsources raw materials and makes most of its sales domestically. However, it should be considered that the sector sells value-added products to the country. Therefore, if the copper sector did not sell products to the country, the current need would have to be met entirely from abroad. With this contribution, the sector has a reducing effect on Türkiye's current account deficit. As shown in Table 28, the copper sector supplies approximately 3 billion dollars of products to the country.

Source: Trademap and TurkStat.

Table 28: Approximate Value and Amount of Products Sold Domestically, 2021

	Million Dollars	Ton
Products Produced in Türkiye	6,147.7	732,045.3
Products Exported Abroad	2,212.17	221,395.0
Products Sold in the Country	3,935.57	510,650.32

2.3. Key Indicators Affecting the Sector

2.3.1. Copper Reserves and Smelter of Türkiye

According to the General Directorate of Mineral Research and Exploration (MTA), Türkiye's copper reserves are between 3.6 and 4 million tons as metallic Cu.

Source: MTA (2015).

Table 29: Copper Mine Detected in Türkiye

City	Location	Cu Tenor (%)	Copper Metal Content (tonnes) (Apparent + Probable)
Adıyaman	Sincik	0.95	6,806
Adıyaman	Tut	0.19	47,804
Adıyaman	Merkez	0.35	47,022
Artvin	Murgul/Damar	0.30	80-100000
Artvin	Murgul/Çakmakkaya	0.84	47,997 (Finished)
Artvin	Murgul/Aksen	2.24	13,000
Artvin	Cerattepe	3.50	250,000
Artvin	Seyitler	1.41	34,752
Balıkesir	Havran	0.33	79,092
Çanakkale	Arapuçuran	1.25	15,375
Çanakkale	Gökçeada	0.19	221,697
Çanakkale	Gökçeada	0.13	29,166
Çanakkale	Gökçeada	0.15	31,155
Diyarbakır	Çermik	0.84	1,877
Elazığ	Ergani/Anayatak	1.71	12,000
Elazığ	Sivrice	0.26	10,475
Erzurum	Oltu	0.20	512
Giresun	Espiye/Lahanos+Kızılkaya	2.40	57,528
Giresun	Tirebolu/Harköy	1.90	8,740
Kahramanmaraş	Elbistan	0.18	1,520,547
Kastamonu	Küre/Bakibaba+Aşıköy	2.50	450,000
Kastamonu	Merkez	0.85	33,733
Ordu	Gölköy	0.14	1,009
Rize	Çayeli/Madenköy	1.50	35,000
Siirt	Şirvan/Madenköy	2.00	500,000
Sivas	Koyulhisar/Kan	1.73	16,683
Trabzon	Of/Kotarakdere	1.31	12,600
Trabzon	Of	0.35	58,006
Trabzon	Of	0.40	21,541
Trabzon	Yomra/Kanköy	1.11	36,741
TOTAL			3,790,235

Türkiye's only smelter is owned by Eti Bakır which has an annual capacity of approximately 90 kilotons.



OUTLOOK OF THE SECTOR IN TÜRKİYE

2.3.2. Foreign Dependence on Raw Materials of Türkiye

Türkiye imports approximately 366 kilotons of refined copper annually. This import amount shows that the sector is foreign-dependent at the rate of 76% in terms of raw materials. Therefore, copper raw material prices directly affect the sector.

Source: London Metal Exchange (LME).

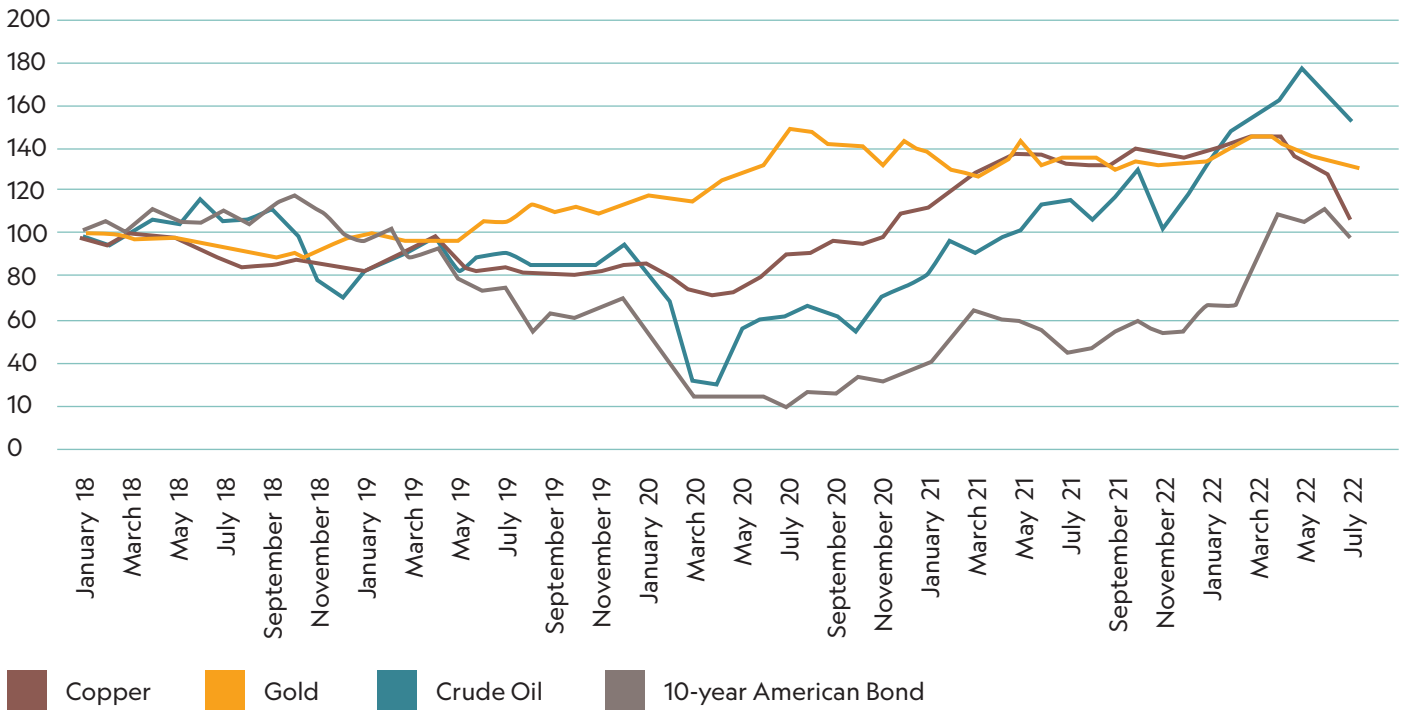
Figure 41: Copper Price Per Ton Between 2018 and 2022 (Dollars)



When the values in January 2018 are taken as 100 basis points, the changes in copper, gold, 10-year US bonds and crude oil values are given in Figure 42. In November 2021, the biggest increase is in copper prices with an increase of 37.84%. When it comes to July 2022, it is seen that the increase in copper prices follow the crude oil and gold prices and is almost at the 2018 price level.

Source: LME & Investing.

Figure 42: Change in Value of Copper, Gold, 10-Year US Bonds and Crude Oil (January 2018=100)





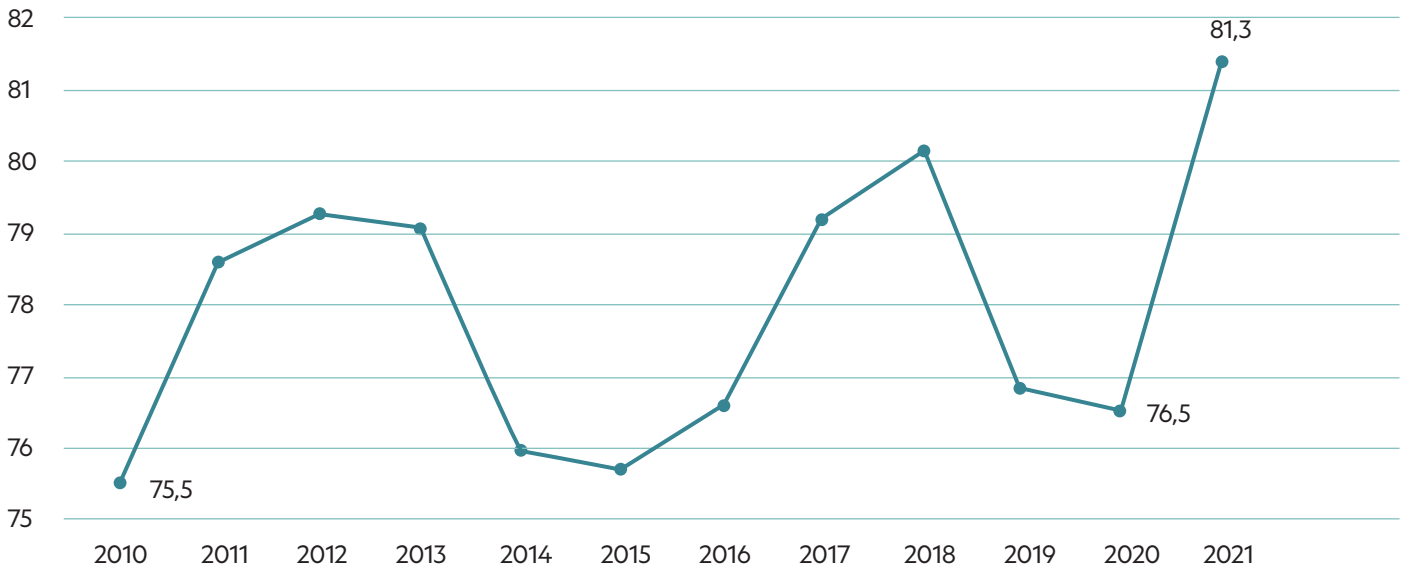
OUTLOOK OF THE SECTOR IN TÜRKİYE

2.3.3. Capacity Utilization Rate and Efficiency of Türkiye

Türkiye's basic metal industry capacity utilization rate is around 80%. Sector productivity, on the other hand, tends to increase in recent years.

Source: CBRT Electronic Data Distribution System.

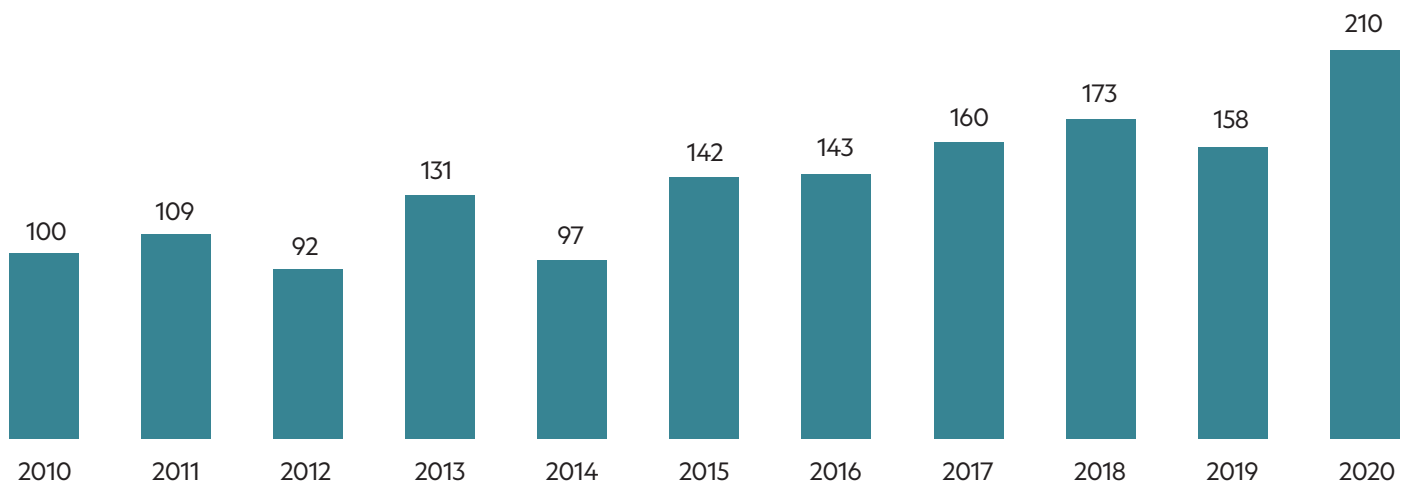
Figure 43: Turkish Basic Metal Industry Capacity Utilization Rate (%)



When the productivity of the sector is considered as added value per employee and when 2010 is taken as 100 basis points, the productivity has increased to 210 in 2020.

Source: Ministry of Industry and Technology.

Figure 44: Copper Sector Annual Productivity (2010=100) (Added Value per Employee)



2.4. The Place of the Sector in the National Development Plan

The copper industry has been given an important place in the current 11th National Development Plan:

Plan Period Perspective:

The 2023 export target of our Ferrous and Non-Ferrous Metals sector is 25 billion dollars, and the 2023 export target of our copper sector is 6 billion dollars (Türkiye Cumhuriyeti Kalkınma Bakanlığı, 2018).

General Objectives:

Establishment of a Copper Institute in cooperation with the private sector, unions, universities and the state in order to support R&D activities and to be integrated with the world in relation to the sector,

Organizing a workshop to ensure that regulations regarding import and export are made in order to be permanent in the EU market,

Taking the necessary political and economic steps to bring the production activities shifting from West to Eastern Europe to our country.

Main Objectives and Policies for the Goals Specified in the Plan:

It was emphasized to take technological investment decisions for the copper sector and to establish an institute that works actively for the copper sector to carry out R&D activities, to represent the sector in international meetings and committees, in short, to explain the advantages and quality of the Turkish copper sector in Türkiye to the whole world. Attention was drawn to taking into account the future needs of the country by making inventories in the sectoral sense and creating road maps accordingly.

It is stated that technological investment is generally not available for excess capacity of brass, except for strip, and the investments made may be low-tech. In this context, it is stated that providing technological information and keeping it up-to-date would contribute greatly to the sector.

According to the plan, there is idle capacity in copper facilities. And increasing the incentive applications to

3 billion dollars

While our country imports approximately 3 billion dollars' worth of copper cathodes annually.

encourage high value added investments to be made accordingly is extremely important for the future of the sector.

The studies in copper mines should be included in the scope of strategic government incentives and the relevant legislation should be updated at the point of copper being a strategically important metal.

The decrease in the export of copper raw materials in our country is given as another important issue for the copper industry, which is dependent on foreign raw materials.

The preparation of detailed reports on metal production from the mine is seen as an extremely important step for the sector. The inadequacy of smelters causes our minerals to be sent abroad. It is necessary to establish a smelter facility to process the minerals of other countries by making solid agreements in places that are logistically convenient. Copper raw material is a scarce resource in high demand worldwide, both in cathode and scrap form. While our country imports approximately 3 billion dollars' worth of copper cathodes annually, 80,000 tons of metallic copper (approximately 500 million dollars' worth) in the produced copper ore is exported as concentrate. The smelting facilities to be established would prevent this situation, and also an important contribution would be made to the reduction of the current account deficit and be an important step towards ensuring the safety of raw materials. The Government should encourage these initiatives with special supports. It was emphasized that the copper resource available in Türkiye should be processed in smelters instead of exporting them abroad, making it into refined copper in the country, meeting country needs first and prioritizing them in the five-year plan by providing maximum support.



2.5. SWOT Analysis

2.5.1. Strengths

1. Production of quality products in international standards,
2. Dynamic structure of companies, flexibility in production,
3. Strong structure of automotive, white goods, shipbuilding, infrastructure and construction sectors,
4. Manufacturers that can produce in European standards and recognized with their overseas projects,
5. Logistics and strategic advantages brought by the geographical location of the country, our location in a location that can provide fast service to Europe, especially during the pandemic period,
6. Ability to export technology for foreign demands,
7. Having a manpower with high management skills, experience and knowledge,
8. Existence of a successful manufacturing sector in production and export,
9. The level of quality that the sector has reached and the export potential and knowledge based on it.

2.5.2. Weaknesses

Raw Material

1. Depletion of copper reserves, inability to put new mineral deposits into operation at the same rate,
2. Insufficient exploration and operation of Turkish mines,
3. Insufficient smelter (1 plant: Eti Bakır) and its high investment requirement,
4. Foreign dependency in raw materials (copper and copper alloys producer) and insufficient domestic raw material production,
5. Exporting the concentrate obtained from the country's copper deposits without turning it into a high value-added end product,
6. Inadequacy of domestic plant, equipment and service production and foreign dependency in investment goods,
7. Increased imports of raw materials.

Legislation and Incentives

1. Cessation of non-EU state aid to investments (for example, copper has been relegated to the Move Programme),
2. Continuing deficiencies in compliance with EU environmental standards,
3. Inadequacy of the mechanisms to prevent the import of poor quality and cheap products,
4. Imposed additional taxes that cause cost increase on the general production sector,
5. High cost of the environmental contribution received by the Ministry of Environment, Urbanization and Climate Change,
6. Difficulty of accessing and systematically monitoring commercial statistical information,
7. Difficult and costly scrap import legislation for contract manufacturing.

Country Risks

1. Unstable exchange rate,
2. Despite the production in world standards, they do not prefer to work due to the country risk and being a producer from outside the EU,
3. Inadequate railway infrastructure,
4. Unfair competition caused by informality in domestic product and end product trade,
5. High input costs, especially energy, compared to competing countries (dependence on monopoly suppliers in natural gas and electricity),
6. Banking sector in gray listing.

Weaknesses of Businesses

1. Lack of capital, difficulty in accessing finance and high financing costs, difficulties in obtaining investment and business loans under competitive conditions,
2. Unfair competition with foreign competitors in credit insurance,
3. Inadequate commercial, scientific and technological relations between companies, in the university-state-industry triangle and with international organizations,
4. The necessity of growth of medium and large enterprises, the fragile structure of small enterprises,

5. Multitude of small-scale producers with low production technologies and product quality,
6. The companies in the sector are predominantly family businesses and have deficiencies in institutionalization,
7. Inadequacy of overseas marketing, customer approach and promotional activities (deficiencies experienced in the process of obtaining foreign accreditation),
8. Marketing weakness in new products and target markets for small businesses,
9. Insufficient production of high value-added products,
10. Low profit export,
11. Lack of middle-level workforce, shortage of intermediate staff.

2.5.3. Opportunities

1. Increase in demand for copper due to the fact that copper is 100% recyclable and due to technology and green demand around the world: Increasing copper consumption in electric vehicles, renewable energies, windmills,
2. Opportunity to get a share from the refined copper production sector, which has moved to Eastern Europe, as we have an established industry,
3. There is a growth potential in sectors with high metal consumption such as automotive, durable consumption and shipbuilding industry, Türkiye's tendency to become the hub of automotive industry and side industry of the region,
4. Geographical proximity to growing markets such as the Middle East and Eastern Europe, the expected increase in demand from these countries,
5. Having a high level of technical knowledge and following up technological developments closely,
6. The existing facilities are geographically close to the domestic customers,
7. Decreased European competitiveness in the production of certain products.

2.5.4. Threats

1. Rival countries provide varying state aids to their producers,
2. There are countries that protect their domestic markets and support exports in raw materials, semi-finished and finished products,
3. Presence of protective measures in export markets,

4. Involvement of governments in the decision-making mechanism of large projects with sales opportunities,
5. Free Trade Agreements signed by the EU with third countries do not cover Türkiye,
6. Sensitization of environmental requirements and high costs of compliance with the Kyoto Protocol,
7. As a result of the horizontal and vertical consolidations in the global metal sector, the formation of strong competitors and the tendency to be dependent on a limited number of raw material producers,
8. The effect of the ongoing political instability in some Middle Eastern and North African countries on our exports,
9. The crisis in the European Union has resulted in narrowing our exports to the EU and increasing our imports from the region,
10. High value-added product investments of Eastern European copper producers,
11. The rapid increase trend in the exports of countries such as China, India and Japan to Türkiye,
12. Record high increases in raw material prices and price uncertainties from time to time,
13. Advances in copper and other metal substitutes (aluminum, etc.),
14. Rising logistics costs.



2.6. Barriers and Challenges in the Sector

- It is of great importance to realize recycling by harmonizing the scrap supply with the developed, modified and revised world and European standards. Sellers import and/or export scrap in all EU countries. For this, there is no requirement for a recycling facility and there is no environmental contribution practice. One of the most important priorities of the sector is to ensure that scrap metals are easily brought into the country.
- Factors such as ending the ban on imports of goods originating in Syria and Iraq, and abolition of the requirement for proof of origin for scrap would increase the number of suppliers in the sector in terms of raw materials. Due to the current legislation, copper ingots produced from scrap copper may not be imported into our country. Necessary arrangements must be made in order to import copper scrap and ingots cast from copper scrap from Iraq. In particular, while this raw material opportunity, which is much cheaper than other imported inputs, actually lowers the invoice our country pays for imported copper to a certain extent, it is thought that refining scrap ingots in our country would contribute to the revival of copper refinery facilities that are still idle and to increase employment. Unfortunately, these scrap ingots are heavily exported, especially to Iran and China, giving these countries a competitive advantage.
- Radiation is not just a substance transmitted from abroad. The radiation measurement requirement should be applied not only for scraps coming from abroad, but also for domestic ones. Accordingly, radiation measurement requirement should be introduced to all scrap yards. The entire EU region imports scrap within the scope of its scrap trading activities and does not have any environmental contribution. In Türkiye, on the other hand, traders cannot import. Necessary arrangements should be made so that scrap metal can easily be brought into the country.
- Metal swarf, which is formed by the metal itself, is another critical issue for the foreign dependent copper sector, whose raw material is scrap. Although not for other sectors, but for this sector, it should be easier for scraps in this regard.
- Refined copper, the main input of the sector, has limited resources in Türkiye and imports refined copper and its alloys as partly finished and semi-finished products.
- The problem of raw materials to be brought from abroad for subcontract processing should be resolved. The fact that the inward processing permit requirement has to be taken for every product arriving at the customs slows down the customs processes. Making an import transaction by associating the issuance of the import declaration with the inward processing permit and linking it to the tax, duty and fee guarantee increases the cost. In addition, after the production processes are completed, depending on the goods conditions within the scope of the inward processing permit in the export stage, in response to the demand to prove the situation by conducting an appraisal, the appraisal condition is sought for each time of export and extra fees are requested. It is expected that the problem will be partially resolved if bulk purchase is allowed. The most valuable raw material for the metal sector is chips and parts obtained from the product itself. Giving raw materials to other competitors in the case they cannot be utilized due to high costs causes erosion of the product tonnage sold. While there is an effort to exist in a sector with a high dependence on raw material imports, leaving the raw material to competitors in this way poses a risk for the sector. If the proposed system is not suitable for other sectors, HS-based privilege should be considered.
- It is necessary to establish and develop the necessary legislation in R&D processes for machinery and equipment used in real sector investments related to high value-added and new products that will prevent imports. While examining the legislation, industry and R&D processes should be viewed from a more industrial perspective rather than an academic one. It is extremely important for the sector to facilitate R&D incentives that will prevent imports and to apply them in facilities other than the pilot plant.



- Efforts should be made to create the necessary investment support for the difference that separates imported goods from their added value.

- In developed Western European countries, many facilities are out of service due to the labor costs of the copper sector. These facilities are being moved to Eastern European countries or established in this region. The main reasons for this situation are the high energy and labor costs in the country. The fact that Eastern European countries are more competitive than Türkiye and they have common legislation is also seen as another reason for moving. Due to high costs of the investment facility areas, which are suitable for the sector in terms of logistics, it is necessary to establish legislation regarding the use of state lands.

- It is necessary to review the training policies that provide the qualified workforce required for the production organization. It is necessary to establish specialized vocational schools and colleges at all levels.

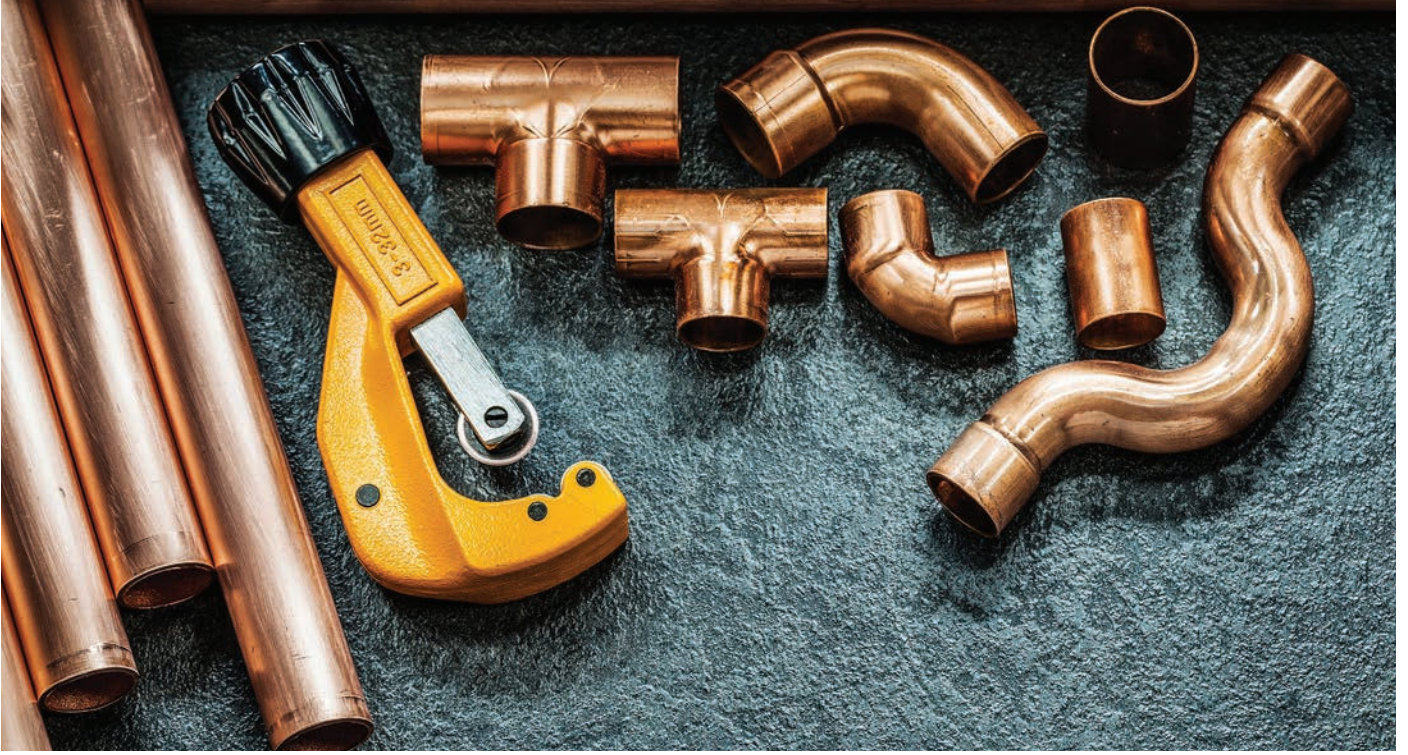
- In recent years, the trend towards copper and copper alloy products in the ventilation sector has been increasing for many reasons, especially for being antimicrobial and environmentally-friendly compared to their cheap counterparts. As a country, we need to attach special importance to the products and sectors in question, which we use in many areas of our normal life.

- Considering the increasing use of copper and brass in submarine, offshore and onshore sectors, it is necessary to attach importance to projects in these sectors.

- Since the developments in the drinking water sector indirectly concern the sectors that include faucets or similar products, it is necessary to pay great attention to the follow-up of European and US standards and full-time implementation. In the Japanese, the US and the EU markets, restrictions on zero or near zero lead in materials in contact with water are in effect. In our country, which exports a large amount to these regions, there is no internal regulation in this sense. In order



OUTLOOK OF THE SECTOR IN TÜRKİYE



not to decrease our export share in the coming periods, such practices and changes should be followed up and necessary regulations should be put into effect and information should be provided on this issue.

- Since the practices developed within the framework of the measures taken for human and environmental health are gaining more importance day by day, various internal regulations should be put into effect by supporting the industrialists in terms of both education and incentives.
- The transition to electric vehicles has started in the automotive sector. We need to be included in this sector at the beginning of this trend to have a significant share in the market. According to a detailed strategic planning report, we believe that we have a potential for spare parts. The domestic automotive industry should consider the fact that approximately 4 times more copper is needed in electric vehicles than in regular vehicles. It is known that lead-free, high-strength new generation brass alloys are used by famous automobile companies. In addition, many R&D activities in the EU for the development of batteries for electric vehicles

continue with university-industry partnership. In this regard, NGOs should cooperate with the government and support the relevant sectors.

- A large amount of copper is also needed in the architectural and decoration sector. In this context, international trends should be followed up and due importance should be given to this potential throughout the country.
- Progress should be made in the manufacture of bushings, bronzes and similar products. In these sectors with potential of many value-added products, it is extremely important to make breakthroughs to gain a share in the world markets. These products can be used in many sectors for their high corrosion resistance. In this sense, necessary investments should be made and encouraged.
- It is known that the use of aluminum and plastic materials used in the ventilation sector is harmful to health. Since copper products are antibacterial, it is emphasized that it would be more appropriate to use copper products instead of those containing aluminum

and plastic materials. In order to prioritize human health, the use of copper, including the use in air conditioner pipes, is extremely important.

- The copper sector is two-dimensional. The first dimension is backward integration and the second is new products. It is predicted that different demands will arise within the framework of new technological standards in the demands of consumers for sectors that include renewable energy and electric vehicles. In addition, it is expected that there will be product groups where regulations will be made regarding the use and content of chemically harmless substances. The sector needs to prepare its technological infrastructure according to the aforementioned situations. On the other hand, on the side of customer, cable manufacturers perform back-integration. The reason for this is the efforts to minimize their own costs. Due to the narrowing of the profit margin in the sector, a backward integration tendency is observed in the customer group addressed by the sector. The main reason for this is that customers also try to reduce their own costs. At this point, it is particularly important that the labor and energy costs of our country's copper sector, as well as the logistics costs should be examined together with the public authority.
- When the brass sector is taken as a basis, it is emphasized that it is necessary to focus on products and markets that can be effective and beneficial in terms of environment and health. For example, this market is gaining importance day by day due to the positive contributions of lead-free brass alloys to humans and the environment, as well as their antimicrobial properties, and suitable markets are being sought in industrially developed countries. In our market, many renovation and breakthrough processes should be conducted in the category of cast products and processed products, such as brass bronze, molding and bushing manufacturing. Although the tonnage used in the world is quite high, our country's share is not at the desired level.
- In large, strategic projects, it is extremely important for domestic production to organize domestic supplier days and invite all public and private sectors. Goods should be purchased from domestic suppliers in many areas from automotive to ventilation and electricity. The sale of copper waste by governmental institutions

should be carried out not only through tenders opened to certain government institutions, but also with the participation of private sector representatives in need of raw materials.

- Guaranteeing the taxes on the inputs used in the production process other than trade will cause a decrease in the cost for the producer. The taxes that come at certain intervals force the producers. This issue should be examined in terms of legislation and necessary improvements should be made. It is a necessity to exempt from tax the anti-dumping products used in production. The increase in the demanded standards increases the costs.
- As a result of imports from some countries, due to the price difference of up to 30 percent between the free and official exchange rates in the country in question, raw materials and semi-finished products from these countries enter the country at prices well below the market conditions. This situation brings our local producers to a level where they cannot compete with the product in question and causes unfair competition. Commercial Counselors are required to monitor exchange rate differences and imports should be followed up in the said countries. Exchange rate differences have a significant impact on the sector.
- It is necessary to ensure political stability, especially to develop relations with neighboring countries. The first step in this direction should be the development of banking networks. The establishment of production facilities should be encouraged.
- Continents such as Africa, South America and Australia, which are difficult to import due to high logistics costs, need to be supported in terms of freight. Where the number of cathode copper suppliers is diversified, it is a necessity to open special lines.
- Required steps should be taken towards improving relations with Algeria and Free Trade Agreements. Changing the perception of Türkiye in all of Africa is extremely important in terms of gaining market share in this region (*Harput, 2007*) (*Türkoğlu, 2016*).

3.

PART:
SUGGESTIONS
TO IMPROVE THE
COMPETITIVENESS OF
THE SECTOR IN TÜRKİYE

The following critical success factors and solution suggestions for the sector are the outputs of the online workshop held on December 21, 2021 with the participation of industry representatives. The list of participants of the said workshop is given at the end of the report.

3.1. Critical Success Factors

Critical factors and possible action areas for the sector to achieve its goals have been identified as follows:

Legal and Administrative Regulations:

In order to strengthen the Copper and Copper Alloys Sector, whose share in exports is increasing day by day, producing intermediate goods for the manufacturing industry, it is necessary to overcome the problems that slow down the growth of the sector by making the necessary legislative studies in the presence of the public.

The Copper and Copper Alloys Sector is one of the sectors using energy most intensively. In terms of input costs, it is known that energy cost ranks second among general costs. High electricity energy costs and additional funds and cuts on costs adversely affect the competitiveness of our exporters in the international market, especially the producers of countries such as Russia, Ukraine and the People's Republic of China.

In addition, the environmental contribution and similar regulations taken from the sector also have an increasing effect on the cost, which adversely affects the competition of the sector.

The technical problems and delays experienced by the sector in the production and foreign trade process should be eliminated by the changes or measures to be taken by the relevant public institutions and organizations in the field of legislation. It is of great importance for our country's economy to increase the current production volume by not allowing the sector having problems arising from the legislation.

The legal and administrative regulations regarding the sector should evolve into a structure where the country can better explain its problems and make its voice heard in order to overcome the obstacles of the copper and copper alloys sector and to develop the sector. For this purpose, the importance of uniting the stakeholders of the sector under a holistic organization emerges. In this way, it is predicted that by providing both consensus and economic unity, there would be more effective promotion and lobbying activities aimed at explaining the importance of the sector in Türkiye's economic development and the obstacles of the sector.

Development of Production Infrastructure:

The dependency on imports and the inadequacy of domestic input use in raw material supply increase production costs, and the widespread use of domestic products negatively affects our production.

The high share of raw materials in the production costs of the sector, the rapidly increasing commodity prices in recent years and the vertical-horizontal integration movements of global companies have negative effects on the competitiveness of the sector. For this reason, it is of great importance to implement a policy such as a rational "Input Supply Policy", which is still working in the leading countries in world trade, such as the EU, the USA, and the PRC.



SUGGESTIONS TO IMPROVE THE COMPETITIVENESS OF THE SECTOR IN TÜRKİYE

One of the main agenda items of the “Export Oriented Production Strategy Evaluation Board”, which was established with the Presidential Circular published in the Official Gazette dated May 12, 2010, numbered 27579 for the purpose of developing the production potential of our country’s manufacturing industry with a focus on export, creating common policies and creating a strategy in which production and exports are handled together, is the “Input Supply Strategy (ISS)” study. As stated above, it is aimed to increase the efficiency and productivity in the supply of the inputs needed by the industry, to reduce the dependency on imports, to increase the added value created in the country, to improve competitiveness and to put forward policy proposals for this. Within the scope of ISS, sector-oriented studies have been completed and the implementation phase of policy recommendations has been reached. Some of the important steps afterwards will be taking measures to support domestic production to increase our production.

On the other hand, unfair competition caused by informality negatively affects registered producers. Keeping proper records of the sector and thus monitoring the current capacity will be of great benefit in terms of measures that can be taken against the problems that may arise in the coming days.

Elimination of Deficiencies in Foreign Trade:

Considering the indirect contribution to the country by producing intermediate products to the manufacturing industry, it is extremely important to remove the barriers of the sector in foreign trade and increase its competitiveness. For this reason, our exports should be supported by developing the logistics infrastructure, free trade agreements should be ensured to cover our country as soon as possible and timely entry to the markets should be ensured.

On the other hand, the import of unsafe products should be restricted by improving the mechanisms that prevent the import of poor-quality and cheap products.

Human Resources:

Supply of qualified intermediate staff is an important problem. There is a need to organize and develop the education in engineering departments of vocational

high schools, vocational schools and universities to meet this need.

As in other sectors, the Copper and Copper Alloys Sector has difficulties in recruiting qualified personnel. Considering the labor-intensive nature of sub-sectors such as casting, the issue of qualified personnel becomes even more important.

R&D Capacities:

Research and development (R&D) activities are a functional tool of technological development and have great importance in product development as well as in the design and manufacture of new products. An enterprise without an R&D infrastructure cannot enter global competition and cannot produce a product range that would give a competitive edge. In the Non-Ferrous Metals Sector, there are advances in the technologies used in the production phase rather than the technologies developed in the products.

The environmental deficiencies of the metal industry can only be solved with new technological investments. For this reason, the relations in the university-industry-state triangle should be strengthened, environments that allow scientific and technological investments to be made and healthy information flow should be created.

3.2. Summarized Solution Suggestions

- Carrying out funding studies to support the exports of the sector, especially by Eximbank, and in this context, evaluating export insurances and limits in accordance with the copper prices traded on dollar basis,
- Developing policies to protect against imports that would lead to unfair competition (especially Iran and Uzbekistan),
- Increasing the promotion and lobbying activities of the sector and its stakeholders by being united under a common organization,
- Establishment of warehouses with London Metal Exchange (LME) accreditation in our country,
- Presenting public areas in logistically favorable regions to investors with government incentives
- Increasing support and government subsidies for equipment renewal and transition to high technology in basic metal and sub-industry environmental investments,
- Establishing a research institute for the copper sector, which actively works to take technological investment

decisions for the copper sector,

- Creating road maps considering the future needs of the country by making detailed inventories in the sectoral sense,
- Removal of the Environmental Contribution Fee applied to the sector,
- Making updates on the Inward Processing permit condition applied to raw materials coming from abroad for contract manufacturing,
- Prevention of scrap exports,
- Removing bureaucratic obstacles in the rapid introduction of new mineral deposits,
- Bringing license assurance, setting a service standard for obtaining and renewing licenses,
- Ensuring that all the concentrate obtained from the copper deposits of our country is converted into the final product in the country,
- In order to meet the need for qualified workforce in the sector, opening required programs in universities (including vocational schools) and expanding vocational high schools, increasing the curricula for copper and alloys production.

3.3. Export and Target Export Markets

As stated in the current 11th National Development Plan;

The Turkish copper sector is considered a sector with a current account deficit, which is extremely wrong. Because within the 74 HSs, there are some HSs in which the Turkish copper sector does not directly export but sells to the domestic market, and in various HSs, it has direct and indirect copper exports with a much higher added value, balancing the total value of imported copper easily in terms of turnover.

Therefore, the products produced by the Turkish copper sector are essentially a very important source of input for sectors such as cables, automotive, white goods, heating and cooling, electronics, sanitary ware, fasteners, electro-technical defense, etc., which are the most important items of the country's exports. The sectors in question are those that make R&D expenditures and that have to constantly develop innovative products to meet the trends in the world. The existence of a developed and strong copper sector that can meet the needs of these sectors will also increase the share of our export items with high added value.

In order to support the exports of the sector, it is of great importance that the exporters access to appropriate financing and that the financing processes are efficient.

In order to achieve this, it is necessary to carry out studies supporting the export of the sector, especially Eximbank. In this context, export insurances and limits should also be evaluated in accordance with the dollar-based copper prices.

3.4. Supply Chain, Logistics

The fact that our country is in an advantageous position in terms of logistics and transportation due to its location provides great advantages to the sector. In addition, improvements in supply chain and logistics will make significant contributions to the sector.

World raw material trade is carried out at the prices determined in the London Metal Exchange (LME) stock exchange and large quantities of raw materials are stored in the warehouses accredited by this stock exchange. Establishment of warehouses with LME accreditation in our country will positively affect Türkiye's import prices. Some of the copper produced in the countries in the region will pass through Türkiye and our country will become a regional logistics hub. At this point, initiatives are underway with authorized institutions to establish a logistics center to house a port and other storage areas, as well as LME approved warehouses in free zone status.

Another important issue is that public areas in logistically favorable regions are presented to the investor with government incentives. Due to high costs of the investment facility areas, which are suitable for the sector in terms of logistics, it is necessary to establish legislation regarding the use of state lands.

The inadequacy of smelters causes our minerals to be sent abroad. It is necessary to establish a smelter facility to process the minerals of other countries, provided that solid agreements are made in places that are logistically convenient.

The copper and copper products sector should be considered as a strategic sector for our country, and it is extremely important to examine the logistics cost as well as the freight prices that have been increasing in recent years, together with the public authority together.

Continents such as Africa, South America and Australia, which are difficult to import due to high logistics costs, need to be supported in terms of freight. Where the number of cathode copper suppliers is diversified, it is a necessity to open special lines.



SUGGESTIONS TO IMPROVE THE COMPETITIVENESS OF THE SECTOR IN TÜRKİYE

3.5. Technology Investment

Investments that need to be made in the field of R&D as it is a technology-intensive sector and in the environment as it is a heavy industry bring serious additional burdens to the sector; however, it is seen that no incentive mechanism has been established in this regard yet.

It is important to support the supply of electrical-electronic-automation-software technologies used in the sector from domestic sources.

The evolution of production in line with the needs of the sectors and in a way that meets the developing technological needs should be supported by working together with steel consumer sectors such as construction, automotive, white goods, machinery and furniture.

Supports and government subsidies should be increased for equipment renewal and transition to high technology in basic metal and side-industry environmental investments.

In order to take technological investment decisions for the copper sector, a research institute should be established for the copper sector that works actively. There is a need for a platform where problems related to the sector, solution proposals and required R&D projects can be managed from a single point. It is thought that the said platform/institute would play an important role in creating road maps by making sectoral inventories and taking into account the future needs of the country. The sector should be personally

supported and promoted by participating in the work of other country institutes on international platforms (for example, German Bakır Institute, ECI).

3.6. Incentives and Legislation

Incentives in Türkiye are generally in the form of increasing the production of intermediate goods and products with high import dependency in order to reduce the current account deficit, supporting high and medium-high technology investments that would ensure technological transformation, and increasing the effectiveness of support elements.

Incentives for copper mining (IV/c group metallic mines specified in the Mining Law) and products and products sector based on copper mining are generally included under the heading of Large-Scale Investments. The expectation of the sector is to include copper mine investments within the scope of Strategic Investments Incentives and to develop an incentive mechanism for supporting exploration drilling for the purpose of finding and developing new reserves.

Legal regulations should provide competitive conditions at the national and global scale and should increase the elements of competition.

The stakeholders of the sector state the necessity of revising the legal regulations according to the conditions of the period and rearranging them considering the changing conditions.

Copper mine investments should be included in the Strategic Investment Incentives.

Support Element

General Incentives

Regional Incentives

Major Investments

Strategic Investments

VAT Exclusion	•	•	•	•
Customs Duty Exemption	•	•	•	•
Tax Discount		•	•	•
Insurance Prem. Employer's Share Support		•	•	•
Income Tax Withholding Support	•	•	•	•
Insurance Premium Support		•	•	•
Interest Support		•		•
Investment Location Allocation		•	•	•
Vat Return				•

11. The legal issues determined in the National Development Plan and expected to be made in order to achieve the sector targets can be summarized as follows:

Removal of Environmental Contribution Fee applicable to the sector:

Sellers import and/or export scrap in all EU countries. For this, there is no requirement for a recycling facility and there is no Environmental Contribution Application. The primary priority of the sector is to ensure that scrap metals are easily brought into the country. Also, in this sense, it is extremely important for the future of the sector to give priority to allowing traders to import scrap, apart from the industrialists. Proof of origin requirement should be abolished in scrap imports.

Making updates to the inward processing permit condition applied to raw materials coming from abroad for contract manufacturing:

The requirement for a separate inward processing permit (IPP) for each good that comes to the country for subcontract labor slows down the customs processes and increases costs. The import declaration is prepared and associated with IPP, and the import process is completed by securing taxes, duties and fees. This process covers a period of about 4 days upon obtaining of IPP. Within the scope of the project, collective DII should be obtained and a 9-month export period should be recognized. In addition, the requirement of proving the situation by having an appraisal done depending on the IPP stock conditions after the production processes are completed both increases the cost and slows down the process. It is expected that the problem will be partially resolved if the bulk purchase and appraisal request is allowed in one go after all exports are completed.

Prevention of scrap exporting:

The most valuable raw material for the metal sector is scrap, swarf and parts obtained from its own product. If we cannot evaluate it periodically due to costs or different internal factors, giving our raw material to other competitors causes erosion of the product tonnage sold. Although it is a sector based entirely on raw material imports, sending raw materials to competitors abroad in this way puts the sector in danger. Even if the proposed system is not suitable for other sectors, HS-based privilege should be considered.

Minimizing X-Ray checks:

Considering that import and export shipments are made with tens of containers, directing each container to x-ray check causes a serious loss of time and reduces the chances of companies to be competitive abroad with the extra cost it creates. Delays arising from implementation should be minimized (the frequency can be reduced, the source can be questioned or a certificate can be issued by independent audit institutions).

Imposing customs duty to third world countries on all copper wire and wire rod imported from Uzbekistan:

All copper wire and wire rods imported from Uzbekistan should be subject to the customs duty applied to third world countries. Approximately 36,000 tons of low-priced and low-quality copper wire rod and wire are imported from Uzbekistan to our country annually. This is due to the foreign exchange legislation in Uzbekistan and other different subsidies. This is causing serious damage to our import sector. Today, the customs duty applied to these imported products is 1.3%; this ratio should be 4.8% for all copper wires, wire rods and cables, in line with the European Union.

In addition, as a result of imports from some countries, due to the price difference of up to 30 percent between the free and official exchange rates in the country in question, raw materials and semi-finished products from these countries enter the country at prices well below the market conditions. This situation brings our local producers to a level where they cannot compete with the product in question and causes unfair competition. It is necessary for the Commercial Counsellors to monitor the exchange rate differences, to follow up the imports in the said countries and to take measures to prevent unfair competition.

Inclusion of works in copper mines within the scope of strategic government incentives:

The studies in copper mines should be included in the scope of strategic government incentives and the relevant legislation should be updated at the point of copper being a strategically important metal. An investigation should be carried out once a year regarding the companies applying for mineral exploration activities, and then work should be carried out to continue the said investigation in the requested lands.



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Necessary facilitations and simplification of legislation should be made in order to minimize the security scanning process and to conclude it in a maximum of two months. Preliminary search studies should be evaluated within the scope of R&D and personnel support should be provided.

Making necessary arrangements for importing copper scrap and copper scrap ingots from Syria and Iraq:

Due to the legislation still in force, the aforementioned scrap copper and copper ingots produced from scrap copper may not be imported into our country. Especially, this raw material opportunity, which is much cheaper than other imported inputs, would actually reduce the invoice that our country pays for imported copper to a certain extent, and would also contribute to the revival of copper refinery facilities, which are still idle, by refining scrap metals and ingots in our country, and to increase employment. Unfortunately, these scrap metals and ingots are heavily exported, especially to Iran and China, giving these countries a competitive edge.

Bringing license assurance, setting a service standard for obtaining and renewing licenses:

Mineral rights must have a strong character, like ownership rights. Suspension and cancellation of mining rights, as well as their acquisition, must be subject to certain rules. The legal framework should provide a predictable environment for those who invest in mining, free from arbitrary practices. The mining law system must balance the legitimate expectations of mineral rights holders from being a licensee and the public interest arising from the operation and protection of mines. Public administrations should also consider mineral rights when making plans and land arrangements. Controls and interventions of mining administrations to mining operations should be predictable and clear. The discretion granted to the administration should not be used arbitrarily. Special courts specialized in resolving mining disputes and the specific judicial procedure for mining disputes should be determined, as in the case of Chilean practice, which removes the administrative discretion. Alternative resolution methods other than arbitration and judiciary in mining disputes should be made operational.

Removing bureaucratic obstacles in the rapid introduction of new mineral deposits:

Standard services related to permits and licenses for the exploration period and the operation period should be announced on the institution's websites.

Elimination of problems in customs due to country policies:

A protection regime should be introduced in imports and different practices for the refund of customs duties should be abolished. It is not possible to compete with Russia, China and Arab countries where input costs are low.

Ensuring that all of the concentrate obtained from the copper deposits of our country is converted into the final product in the country:

In order for the smelting plants for metal recovery to meet the country's needs, necessary support mechanisms should be developed, and in this context, measures should be taken to prevent the outflow of raw materials.

Developing measures to develop foreign trade with neighboring and surrounding countries, to enable our exporters to compete with their competitors in foreign markets on equal terms, to increase our international competitiveness through mutual investments and joint ventures:

It is important that domestic companies operating in the country benefit from all kinds of opportunities in order to show a stronger presence in foreign platforms, and gain the ability to act together with pre-competition cooperation projects.

3.7. Need for Qualified Workforce

In order to adapt to modern conditions with Industry 4.0 and digital transformation, which have created shocking changes in many sectors in the world in the last few years, it is seen that one of the most important issues observed throughout the sector is the lack of personnel and the insufficient education of newly graduated engineers. As our sector and the developments in the

sector have not been adequately introduced, it is clear that as a result of the changing conditions, metallurgical and materials engineering education of universities has shifted to the axis of materials science, which mainly focuses on the properties of solid materials.

One of the most important problems encountered in the casting sector in the world and especially in the European Union countries is the gradual decrease in the number of qualified personnel and the inability to bring young people into the sector. One of the main reasons for this situation is the insufficient introduction of the developments in the industry. Another is that academic research and programs concentrate more on nano materials, composites, ceramics and advanced technology materials in line with new technological trends.

For the sector to increase the employment of qualified workforce, technical staff and engineers, it is important to open related programs at universities. Vocational high schools should be expanded as educational institutions that provide qualified intermediate staff for the copper and copper alloys sector, universities should be supported to provide associate degree programs directed to the sector (Rolling Technologies, Smelting Technologies, etc.) at the Vocational School level to raise qualified technicians and first-level manager candidates needed by the sector, and the curricula to produce copper and copper alloys in the departments of Mining, Metallurgy and Materials Engineering of universities should be expanded, research projects should be supported, and practices that will be in close cooperation with the industry should be implemented.

Again, in order to increase the level of education for the relevant business line, support should be given to master's, graduate and post-graduate research programs abroad, and it should be ensured that experienced and competent people from the sector can give practical lectures at universities with titles such as lecturer/guest.

It is also important to encourage employment of the graduates of technical education faculties as intermediate staff in the sector, to close the shortage of trained personnel, to support educational studies, and to develop cooperation between universities and the industry in cooperation with TUBITAK.

3.8. Productivity

The World is entering the age of unmanned smart factories that are self-sufficient and self-managed. In factories with digital intelligence, which are planned to be self-sufficient, the communication of objects with each other and with people through the systems implemented by the correct analysis of big data, constitutes the basic logic of Industry 4.0 operation.

The fact that the machines in the factory inform each other, that the products are produced automatically by who and when, that the robot-machines work continuously and in environments that are not suitable for human work will reduce the possibility of error.

The mechanism created by this communication eliminates the problem of making decentralized decisions and provides an increase in productivity. Big data will be used in manufacturing and service businesses to optimize processes, use resources efficiently, maintain and increase quality.

For example, the leadership of Germany, one of the two leading countries with the USA within the framework of the 4th Industrial Revolution, in digital transformation, automation and efficiency is also striking in the production statistics per facility. It is clear that our country has a serious potential in this field with the investments it will make.

The inclusion of investments in the field of environment and efficiency within the scope of incentives will make it easier for our sector, which makes a significant export contribution, to cope with the tough competition conditions and will make a serious contribution to its production and export potential.

3.9. Workshop Participants

The participants of the online workshop held on December 21, 2021 with the participation of industry representatives are given below.

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