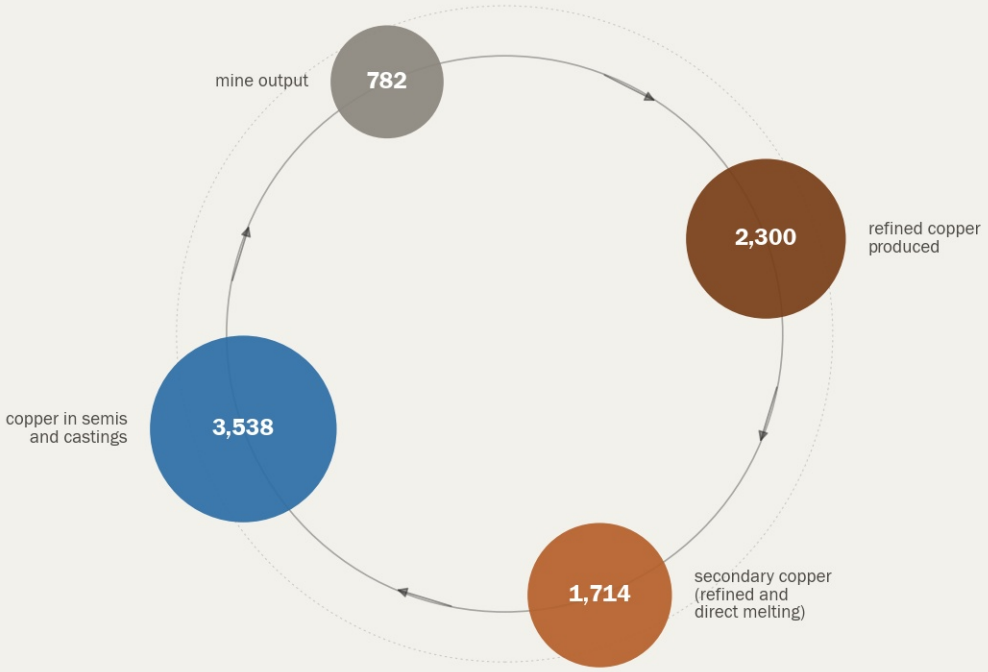
IGMNiR
Economic Chamber of Non-Ferrous Metals and Recycling

Copper in the EU-27, 2024 (kt Cu; circle area ∝ tonnes)



IGMNIR REPORT · NOVEMBER 2026

Copper in the EU-27 economy

Value, circularity and security of supply

An integrated assessment of the copper industry in the European Union (CU-EU model)

Base year 2024 · Dynamic stock model 1960–2035 · Transparent, reproducible model

About this report. This report was prepared by the Economic Chamber of Non-Ferrous Metals and Recycling (IGMNiR). It presents CU-EU, an integrated model that estimates the economic, fiscal, environmental and strategic contribution of the copper industry to the economy of the European Union. The 27 Member States are treated as one economy: deliveries between Member States are domestic, trade with countries outside the EU is foreign trade. The model distinguishes six segments – copper mining (E0), collection and trading of copper scrap (E1), secondary smelting and refining (E2), primary smelting and refining (E3), copper and copper-alloy semis and castings (E4) and the copper in wires and cables (E5). The smelters and refineries of KGHM Polska Miedź belong to an enterprise classified to mining (NACE 07.29) and are therefore part of E0. A dynamic model links the industry to the copper stock in European buildings, infrastructure and products. The annexes list all parameters and sources. The report was prepared with the support of artificial-intelligence (AI) tools for data processing, modelling and drafting.

Data cut-off: statistics 31 October 2026; legal and policy status 9 November 2026. **Base year:** 2024 (structural business statistics, PRODCOM, company reports; Aurubis fiscal years ending in September); trade data to 2025. **Currency:** EUR, current prices. **Model version:** CU-EU v1.1 of 10 November 2026 (run ID CUEU-1.1-ee42378f93; random-number seed 20261118, a fixed numeric identifier). **Suggested citation:** IGMNiR (2026), *Copper in the EU-27 economy: value, circularity and security of supply. An integrated assessment of the copper industry in the European Union (CU-EU model)*, Economic Chamber of Non-Ferrous Metals and Recycling, November 2026.

Contents

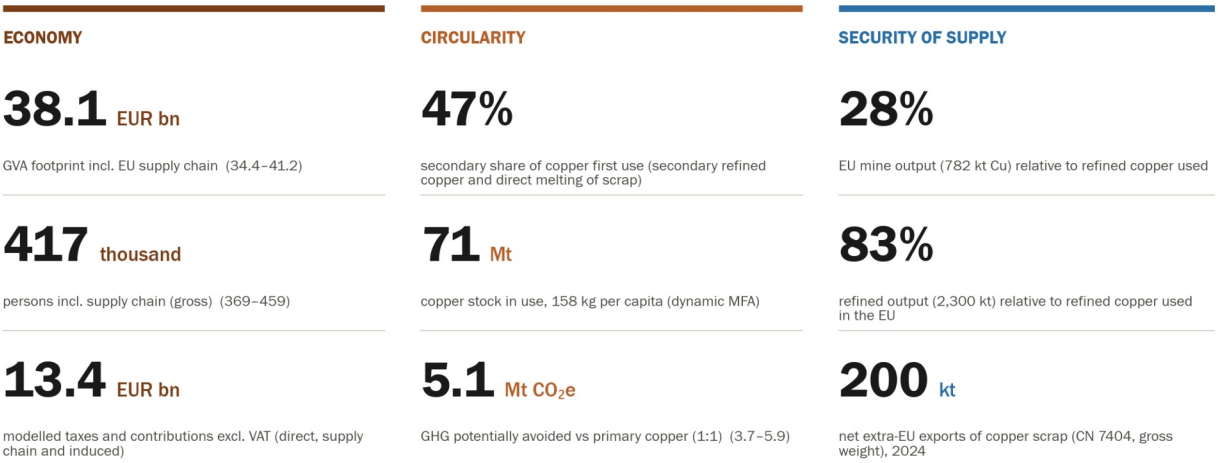
Key findings....3
01 Introduction....5
02 Policy and regulatory context....7
03 The copper industry in the EU-27....11
04 The CU-EU model....18
05 Economic and fiscal contribution....22
06 Copper in use and scrap supply....29
07 Environmental contribution....31
08 Strategic contribution....35
09 Uncertainty, checks and limitations....38
10 Scenarios to 2035....42
11 Summary....44
A Data sources....45
B Parameters and uncertainty ranges....48
C Installations of the copper value chain....52
D Glossary....53
References....54

How to read the numbers. *Observations* (O) are published statistics and company data – Eurostat structural business statistics (SBS), national accounts, input-output tables, PRODCOM and Comext, the EU emissions registry and company reports. *Estimates* (E) combine observations with allocations or calibrated parameters – the copper shares of mining, scrap trading, castings and cables, the split of NACE 24.44 into smelting and semis, and the copper from scrap melted directly by semis producers, derived from a copper bridge. EU aggregates of SBS are partly confidential or rounded by Eurostat; missing 2024 cells are completed from member-state sums or from ratios of earlier years and carry status E, and rounded cells are used as published. *Model results* (M) depend in addition on counterfactual or dynamic assumptions – supply-chain and induced effects, modelled taxes, the copper stock in use, the emissions and other burdens potentially avoided and the scenarios. Economic results are gross contributions; value added is at factor cost. Compensation of indirect emission costs, known for copper only in Germany and for KGHM (Section 2.3), is not deducted. Taxes are model estimates (incl. the KGHM mineral extraction tax), not a net fiscal balance.

Key findings

The EU-27 mined 782 kt of copper in 2024, refined about 2,300 kt and used about 2,760 kt of refined copper. Together with about 860 kt of copper from scrap melted directly by semis producers, this became about 3,540 kt of copper in wire rod, bars, strip, tubes, foil and castings. Secondary copper – scrap melted directly and secondary refined copper – supplied 47% of the copper first used in the EU.

FIGURE 1 The copper industry in the EU-27 at a glance



Central estimates for 2024; ranges in brackets = P5–P95 of 10,000 Monte Carlo draws within the model structure. Extended value chain: copper mining (incl. integrated smelting of KGHM), collection and trade of scrap, secondary and primary smelting and refining, semis and castings, copper in wires and cables. GHG: conditional, substitution-based estimate, largely outside the EU. Source: IGMNiR CU-EU v1.1.

SEVEN FINDINGS

- **Value.** The extended copper value chain generated about EUR 19.6 billion of gross value added in 2024 and employed about 183,000 people. Including the supply chain inside the EU the footprint is EUR 38.1 billion and about 417,000 jobs (90% band EUR 34.4–41.2 billion). These are gross contributions associated with the activity, not the effect of its loss. Semis and castings (E4) and cables (E5) account for 56% of direct value added, mining including KGHM's smelters (E0) for 25%. Value added of primary smelting reflects the treatment charges of 2024, which fell to zero for 2026.
- **Recycling.** The recycling chain – collection and trade of scrap (E1) and secondary smelting and refining (E2) – generated EUR 2,960 million of direct value added and about 30,500 jobs; EUR 5,440 million with the supply chain. These figures exclude the 158.6 kt of copper refined from scrap by KGHM, whose smelters are part of E0. Semis producers that melt scrap directly account for a further EUR 1,300 million in proportion to their scrap input.
- **Public finances.** Activity in the extended chain is associated with about EUR 13.4 billion of taxes and social contributions excluding VAT (90% band EUR 12.1–14.6 billion), most of it on labour; the Polish mineral extraction tax paid by KGHM adds about EUR 810 million beyond the average production taxes of mining. Member States paid EUR 5.52 billion of compensation for indirect emission costs to all eligible sectors in 2024; copper-specific amounts are known only for Germany and for KGHM.
- **Copper in use.** The dynamic model estimates the copper stock in use in the EU-27 at about 71 Mt (158 kg per person; 90% band 139–179), within the range of 140–200 kg of published studies. End-of-life products released about 2,590 kt of copper in 2024, of which about 1,480 kt was recovered (57%).

- **Environment.** Depending on the counterfactual, secondary copper produced in the EU potentially avoided between about 1.1 and 5.7 Mt CO_2e in 2024. With one-for-one replacement of global average primary copper the value is 5.1 Mt in the central run and 4.8 Mt as the median of the draws (90% parameter band 3.7–5.9 Mt, which does not cover the choice of counterfactual); counting only copper of end-of-life origin, which excludes fabrication scrap circulating within manufacturing, 3.9 Mt. If the displaced copper had the footprint of the primary part of EU production (about 2.0 t CO_2e per tonne; the producer averages of Aurubis, 1.29 t, and KGHM, 1.69 t, include recycled feed), the result would be about 2.3 Mt (Chapter 7). Verified emissions of the named copper smelters, refiners and semis plants in the EU ETS were about 1.92 Mt CO_2e in 2024.
- **Security of supply.** EU mine output equals 28% and EU refined output 83% of refined copper used in the EU (22% and 63% of copper first used); secondary copper equals 47% of copper first used, copper of end-of-life origin alone 36% (26% at a new-scrap rate of 25%) – against the CRMA reference values of 10% (extraction), 40% (processing) and 25% (recycling), which apply to strategic raw materials in general and to capacity in 2030; refining rests largely on imported concentrate, and the extraction stage depends on imports for about 72% of refined copper used. Concentrate imports come mainly from Brazil (23%; HHI 1,520), refined copper imports from Chile (38%). The EU exported 200 kt more copper scrap (gross weight) than it imported, 43% of exports going to China.
- **Outlook.** In the high-circularity scenario for 2035 secondary copper rises to 1,970 kt and direct value added to EUR 22.3 billion; the additional secondary feed exceeds the growth of domestic scrap projected by the dynamic model by about 142 kt of copper – more than the net extra-EU exports of copper in scrap in 2024 (69 kt) and less than gross exports (395 kt).

TABLE 1 **Headline results: central estimate and 90% parameter-uncertainty band**

Indicator (2024)	Status	Central	P5	P50	P95	Unit
Direct GVA – recycling chain (E1+E2)	E	2,959	2,414	2,994	3,628	EUR m
Direct GVA – copper industry (E0–E4)	E	14,010	13,209	14,000	14,772	EUR m
Direct GVA – extended value chain (E0–E5)	E	19,578	18,482	19,561	20,641	EUR m
GVA incl. supply chain (Type I)	M	38,061	34,397	37,763	41,193	EUR m
GVA incl. induced (Type II)	M	47,326	42,726	46,954	51,290	EUR m
Direct employment	E	183,300	170,900	183,100	195,800	persons
Jobs incl. supply chain	M	416,800	369,200	412,700	459,200	persons
Jobs incl. induced	M	538,200	475,700	532,700	593,900	persons
Taxes and contributions (attribution, not net balance)	M	13,403	12,078	13,276	14,572	EUR m
GHG potentially avoided – secondary copper produced	M	5,129	3,749	4,794	5,904	kt CO_2e
– of which secondary smelting and refining	M	2,244	1,458	1,990	2,489	kt CO_2e
GHG potentially avoided – end-of-life copper only	M	3,935	2,803	3,661	4,609	kt CO_2e
GHG potentially avoided – substitution 0.5	M	2,010	1,183	1,782	2,373	kt CO_2e
Tailings potentially avoided	M	160	140	162	189	Mt
Secondary copper (direct melting and secondary refined)	E	1,714	1,522	1,737	1,995	kt Cu
Copper stock in use	M	71	62	71	81	Mt Cu
Old scrap recovered from end-of-life products	M	1,480	1,257	1,454	1,661	kt Cu
Unaccounted-for copper (balance residual)	M	−38	−287	15	328	kt Cu
Secondary share of copper first use	E	47	43	47	51	%
Coverage ratio: domestic scrap supply / scrap used	E	104	102	104	107	%

Source: IGMNiR CU-EU v1.1; Monte Carlo 10,000 draws with Gaussian copula; "central" is the deterministic run with modal parameter values. P5–P95 describe parameter uncertainty within the model structure; structural alternatives give a wider range (Chapter 9). With the EU-27 symmetric input-output table of Eurostat (2023) instead of FIGARO 2024, GVA including the supply chain differs by 0.5%. Segments E0–E5: see Chapter 4. GVA, jobs and taxes are gross contributions; direct GVA is at factor cost from SBS, indirect and induced GVA at basic prices from FIGARO (valuing direct GVA at basic prices changes GVA including the supply chain by 0.8%). Type II effects assume that household spending responds to income at constant propensities without supply constraints. Taxes exclude VAT. Emissions potentially avoided compare secondary copper produced in the EU with 1:1 substitution of global average primary cathode; they occur largely outside the EU and are not changes of the EU inventory; the perspectives are alternatives and are not additive. Unaccounted-for copper: residual estimate of domestic scrap supply less the bottom-up estimate; a negative value means that the bottom-up supply exceeds the residual. Coverage ratio on the residual basis: 1 plus net scrap exports relative to scrap used. The recycling chain (E1+E2) does not include the copper refined from scrap by KGHM (158.6 kt), whose smelters are part of E0; the physical and emission results include it.

01 Introduction

Copper conducts electricity and heat better than any other non-precious metal, resists corrosion and can be recycled repeatedly without loss of quality. These properties make it essential for power grids, electric motors, buildings and vehicles. The European Union is both a producer and a large user of copper. Its mines produced 782.3 kt of copper in 2024 – mainly in Poland, Spain, Bulgaria, Sweden and Portugal (Reichl and Schatz 2026) – its smelters and refineries about 2,300 kt of refined copper, and its apparent use of refined copper was about 2,760 kt. EU semi-fabricators produced 1,960 kt of wire rod and a wide range of bars, strip, tubes and foil (Eurostat 2026b), and its cable industry produced about 4.2 Mt of insulated wires and cables (gross weight, PRODCOM 27.32). Copper is a strategic raw material under the Critical Raw Materials Act.

This report treats the EU-27 as one economy. Copper that moves between Member States – concentrate from Portugal smelted in Spain or from Sweden smelted in Finland, cathode from Belgium rolled in Italy, scrap from France melted in Germany – is a domestic flow; only trade with countries outside the EU is foreign trade. Earlier IGMNiR reports analysed copper in Poland, Germany and Italy; CU-EU applies the same integrated model to the Union as a whole.

1.1 Questions addressed

01 How large is the copper industry in the EU – in output, value added and jobs – and how is it organised along the value chain?

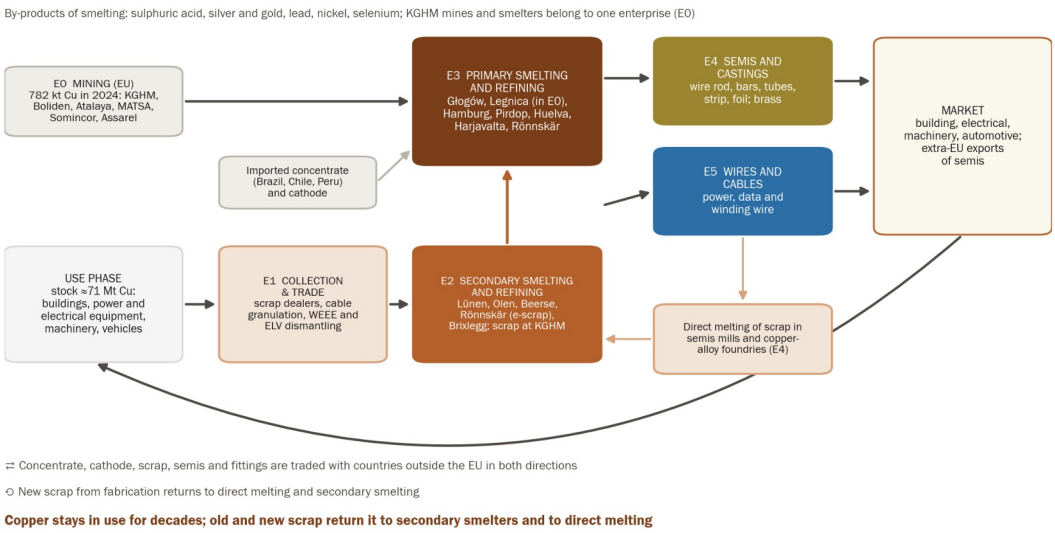
02 How much value added, employment and tax revenue does it support in the EU supply chain and through household spending?

03 How much copper is in use in the EU, how much scrap does it release, and how does this compare with the scrap used and traded?

04 Which emissions and other burdens does secondary copper produced in the EU potentially avoid compared with primary copper?

05 How dependent is the EU on imported concentrate and refined copper, how large are its scrap exports, and how might this change to 2035?

FIGURE 2 The copper value chain in the EU-27 and the six segments of the CU-EU model



Source: IGMNiR.

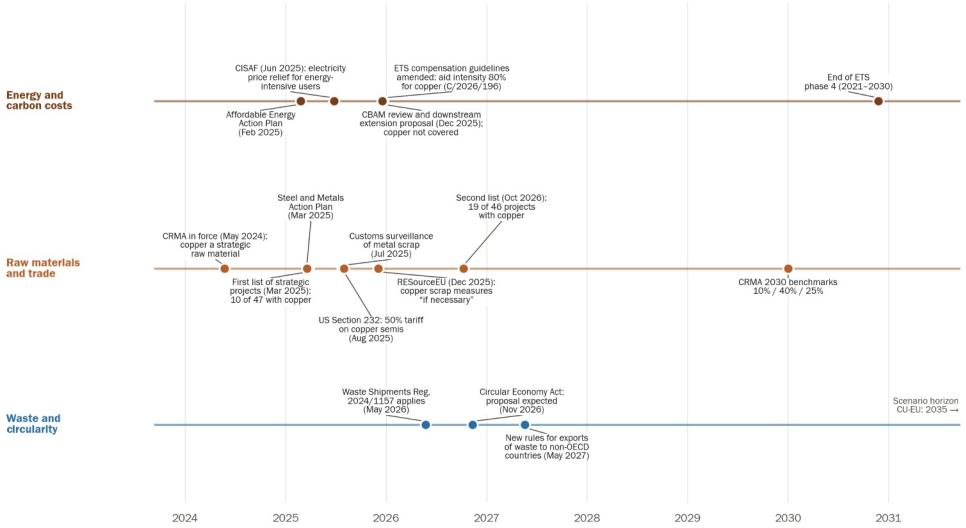
1.2 Structure of the report

Chapter 2 summarises the policy and regulatory context, Chapter 3 describes the industry, its trade and its copper balance, and Chapter 4 the CU-EU model. Chapters 5 to 8 present the economic and fiscal, physical, environmental and strategic results, Chapter 9 their uncertainty and limitations and Chapter 10 the scenarios to 2035. Chapter 11 summarises the results. The annexes document data sources, parameters, installations and terms.

02 Policy and regulatory context

The copper value chain in the EU is shaped by four groups of rules: raw-material policy, trade and waste policy for scrap, climate policy (emissions trading, carbon border adjustment and compensation of indirect emission costs) and the external trade environment. The figure below shows the main milestones; the sections below describe the measures in force on 9 November 2026.

FIGURE 3 Regulatory milestones for the copper value chain in the EU, 2024–2035



Source: Regulation (EU) 2024/1252; Commission Decision (EU) 2025/840; COM(2025) 79; COM(2025) 125; Communication C/2025/3602 (CISAF); DG TAXUD, news of 23 July 2025; US Proclamation 10962 (30 July 2025); COM(2025) 945; COM(2025) 989; Communication C/2026/196; Regulation (EU) 2024/1157; European Commission, second list of strategic projects (IP/26/2113, 9 October 2026); European Parliament, Legislative Train (Circular Economy Act, 25 October 2026); Directive 2003/87/EC. Legal status 10 November 2026.

2.1 Critical Raw Materials Act

Regulation (EU) 2024/1252 lists copper as a strategic raw material (Annex I) and a critical raw material (Annex II). Its benchmarks for 2030 (Article 5) are that EU capacity should cover at least 10% of annual EU consumption of strategic raw materials in extraction, 40% in processing and 25% in recycling, and that no single third country should supply more than 65% of EU consumption at any relevant processing stage. The Commission selected 47 strategic projects in the EU on 25 March 2025 (Decision (EU) 2025/840), ten of which name copper, and a second list of 46 projects on 9 October 2026, of which 19 name copper (European Commission 2025a; 2026a). The tables below list them.

TABLE 2 Strategic projects naming copper – first list, March 2025

Project	Member State	Stage	Promoter
Aguablanca	ES	extraction	Rio Narcea Recursos
CirCular	ES	recycling	Atlantic Copper
Polymetallic primary sulphide project	ES	extraction, processing	Cobre las Cruces
GALLICAM	FR	processing (battery materials)	Sibanye-Stillwater Sandouville
Lombador North Ph. 2, Semblana, 3rd SILO	PT	extraction, processing	SOMINCOR (Neves-Corvo)
POLVOLT	PL	recycling	Elemental
Fortum Hydromet	FI	recycling	Fortum Battery Recycling

Project	Member State	Stage	Promoter
RECOVER-IT	IT	recycling	Circular Materials
Rovina	RO	extraction	Euro Sun Mining
Sakatti	FI	extraction, processing	Anglo American

Source: Commission Decision (EU) 2025/840 of 25 March 2025; European Commission (2025a).

TABLE 3 Strategic projects naming copper – second list, October 2026

Project	Member State	Stage	Promoter
CUPIDON	BE	recycling	Comet Traitements
OREON	BE	processing	Umicore
Tankhouse Expansion Pirdop	BG	processing	Aurubis Bulgaria
Hautalampi Co-Ni-Cu mine	FI	extraction	FinnCobalt
Suhanko	FI	extraction	Suhanko Arctic Platinum
EU BEST STRAT	DE	recycling	cylib
Second TBRC Lünen	DE	recycling	Aurubis AG
ETEOCLES	GR	recycling	ElvalHalcor
Skouries	GR	extraction	Hellas Gold
9PV-up	IT	recycling	9-Tech
REW-ITA green HUB	IT	recycling	OMCD TEK HUB
3ECYCLE	NL	recycling	Mitsubishi Materials Europe
Myne Circular Metals Harderwijk	NL	recycling	Myne
Urban Mining Factory – PCBs	NL	recycling	CRITICAL.
Retków-Grodziszcze deposit	PL	extraction	KGHM Polska Miedź
Integrated Recycling Smelter	PL	recycling	KGHM Polska Miedź
Urban mining	PL	recycling	TDM Electronics
Cobre San Rafael	ES	extraction	Cobre San Rafael
Viscaria	SE	extraction	Gruvaktiebolaget Viscaria

Source: European Commission (2026a), factsheet of 9 October 2026; selection of projects whose materials include copper. 93 strategic projects are now designated in the EU and 13 in third countries.

2.2 Scrap, waste and trade policy

The European Steel and Metals Action Plan (COM(2025) 125 of 19 March 2025; European Commission 2025b) states that EU production covers 83% of EU copper demand, places copper under close monitoring because of the US Section 232 investigation, and announces an assessment of recyclability and recycled-content requirements for steel, aluminium and copper under the Ecodesign Regulation. Since 23 July 2025 the Commission has monitored imports and exports of ferrous, aluminium and copper scrap through customs surveillance (European Commission 2025f). The RESourceEU Action Plan (COM(2025) 945 of 3 December 2025; European Commission 2025c) announced measures for aluminium scrap and stated that similar actions would be considered for copper scrap if necessary; no measure on copper scrap had been proposed by 9 November 2026. The revised Waste Shipments Regulation (EU) 2024/1157 applies from 21 May 2026; its rules on exports of non-hazardous waste to non-OECD countries apply from 21 May 2027, and the Commission published a draft list of authorised destinations on 18 September 2026. Since 1 November 2020 China has allowed free import of recycled copper raw materials that meet national standards; Announcement No. 23 of 2024, in force since 15 November 2024, replaced these rules and covers recycled copper, copper-alloy, aluminium and aluminium-alloy raw materials meeting GB/T 38471, GB/T 38470 and related standards (MEE et al. 2024).

2.3 Emissions trading, carbon border adjustment and compensation

Copper production (NACE 24.44) is on the EU list of sectors exposed to a risk of carbon leakage for 2021–2030 (Delegated Decision (EU) 2019/708) and therefore receives free allocation at the full benchmark level; free allocation for 2026–2030 uses the benchmark values of Implementing Regulation (EU) 2026/1412. NACE 24.44 is also listed in Annex I of the ETS State aid Guidelines (2020/C 317/04) as eligible for compensation of indirect emission costs. The average auction price of EU allowances was EUR 64.74 per tonne in 2024 (European Commission 2025d). The carbon border adjustment mechanism (Regulation (EU) 2023/956) does not cover copper; the extension to downstream steel and aluminium products proposed in December 2025 does not cover copper either (European Commission 2025e). The verified emissions of the copper smelters, refiners and semis plants that can be identified by name in the EU registry were about 1.92 Mt CO_2e in 2024 (table below).

TABLE 4 Verified emissions of copper installations in the EU ETS, 2024 (t CO_2e)

Installation	Member State	t CO_2e
KGHM HM Głogów	PL	920,842
Boliden Rönnskär	SE	256,201
Aurubis Lünen	DE	160,723
Aurubis Hamburg	DE	136,929
Boliden Harjavalta	FI	85,203
Atlantic Copper, Huelva	ES	66,816
Aurubis Bulgaria, Pirdop	BG	47,378
Aurubis Olen	BE	43,141
La Farga	ES	35,872
Montanwerke Brixlegg	AT	34,513
Aurubis Beerse	BE	31,360
Kovohuty	SK	25,887
KGHM HM Legnica	PL	25,678
Sofia Med	BG	22,772
Trafilerie Carlo Gnutti	IT	14,537
KME Germany, Osnabrück	DE	6,438
Other copper plant	DE	4,528
Total		**1,918,818**

Source: European Commission (2026c), Union Registry, verified emissions 2024 (extraction of 1 April 2026); selection of installations by name; the selection may be incomplete (e.g. KGHM Legnica, 0.21 t CO_2e per t of cathode). Activity "production or processing of non-ferrous metals" in the EU-27: 68 installations, 5.37 Mt CO_2e. KGHM power units and Umicore Hoboken (multi-metal) are not included.

Compensation of indirect emission costs is governed by the Guidelines on State aid in the context of the ETS (2020/C 317/04); the amendment of December 2025 (C/2026/196; European Commission 2026b) raises aid intensity for previously eligible sectors, including copper, from 75% to 80% for 2026–2030. In 2024 fifteen Member States paid about EUR 5.52 billion for costs incurred in 2023 to all eligible sectors (European Commission 2025d). Amounts per sector or firm are published only in some Member States: in Germany non-ferrous metals received EUR 369.7 million for cost year 2024, of which the copper-production fallback element about EUR 53 million (1.9% of the total; DEHSt 2026); in Poland KGHM was granted PLN 151.9 million for its 2024 costs by the Energy Regulatory Office (as reported in IGMNiR 2026c).

TABLE 5 Compensation of indirect emission costs paid in 2024 (costs of 2023), all eligible sectors

Member State	EUR million	Installations
DE	2,395.0	707
FR	908.8	293

Member State	EUR million	Installations
PL	614.6	97
GR	287.0	57
ES	282.8	191
BE	249.9	56
IT	165.5	252
NL	147.3	48
FI	143.2	55
RO	116.7	31
CZ	60.4	23
SK	58.3	9
LU	37.6	4
SI	25.4	16
PT	25.0	23
Total	**5,517.5**	**1,862**

Source: European Commission (2025d), Carbon Market Report, COM(2025) 735, Table 6.

2.4 Energy and State aid

Non-household electricity in the EU-27 cost on average EUR 0.123 per kWh in 2024 for consumers of 70–150 GWh and EUR 0.113 per kWh for consumers above 150 GWh, excluding VAT and recoverable taxes (Eurostat 2026b). The Clean Industrial Deal State Aid Framework (CISAF, C/2025/3602, applicable from 25 June 2025 to 2030) allows Member States to grant temporary electricity price relief to energy-intensive users, capped at half of the wholesale price on half of consumption and not below EUR 50 per MWh. The Industrial Accelerator Act proposed in March 2026 (COM(2026) 100; European Commission 2026d) sets low-carbon and Union-origin requirements for steel, cement and aluminium; it does not mention copper.

2.5 External trade: US Section 232 tariffs

Since 1 August 2025 the United States has applied a 50% tariff to the copper content of semi-finished copper products and copper-intensive derivatives (Proclamation 10962; Federal Register 2025); since 6 April 2026 the tariff applies to the full value of semi-finished products (CRS 2026). Ores, concentrates, cathodes, anodes and scrap are excluded. The EU supplied 25% of US imports of semi-finished copper products by value in 2025. EU exports of bars, wire, plate and strip, foil and tubes to the United States fell after the tariff took effect (table below).

TABLE 6 **EU-27 exports of copper semis (CN 7407–7411) to the United States**

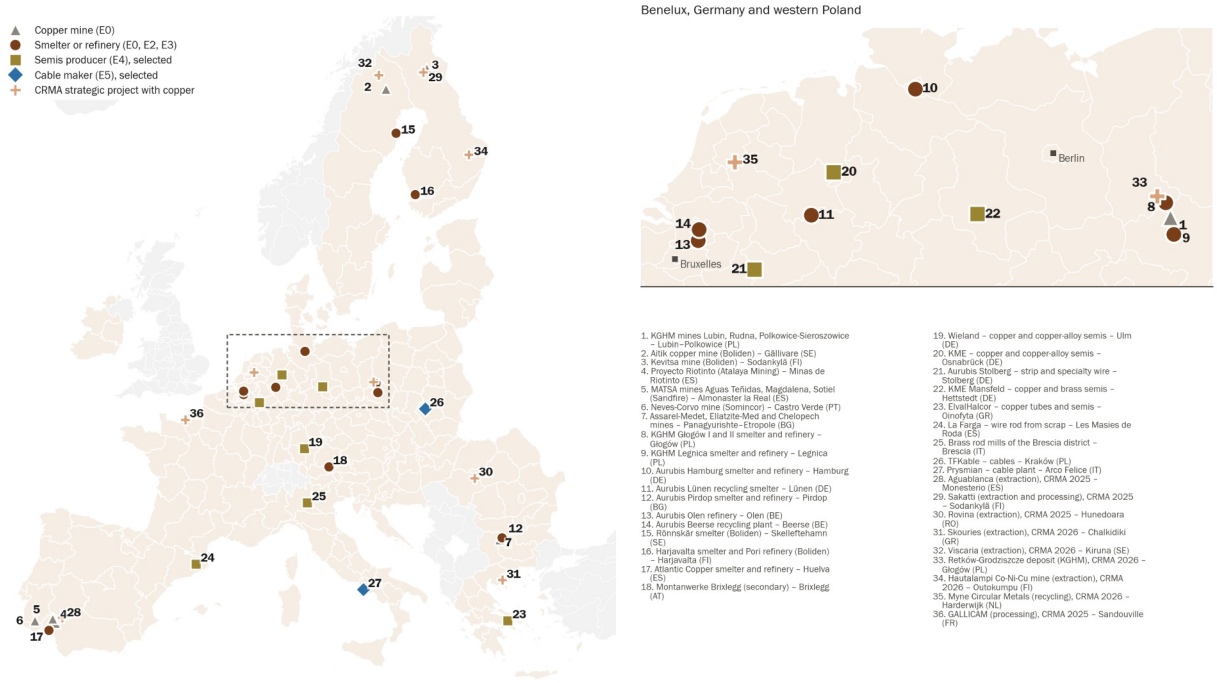
Period	Tonnes	EUR million
2024, full year	88,320	1,108.5
August–December 2024	39,020	484.3
January–July 2025	63,794	774.7
August–December 2025	26,601	353.5
January–August 2024	56,211	711.6
January–August 2025	67,812	825.7
January–August 2026	52,159	789.7

Source: Eurostat Comext (DS-045409), data of 16 October 2026; IGMNiR aggregation. August–December 2025 volume was 31.8% below the same period of 2024; January–August 2026 was 23.1% below January–August 2025. Exports of the same products to all other extra-EU destinations were 3.5% higher in August–December 2025 than a year earlier (245.1 kt against 236.8 kt) and 1.3% lower in January–August 2026 (419.4 kt against 425.0 kt).

03 The copper industry in the EU-27

The EU copper value chain runs from mines in Poland, Spain, Bulgaria, Sweden, Portugal and Finland through custom and integrated smelters in Germany, Poland, Bulgaria, Belgium, Spain, Finland and Sweden, secondary smelters and refiners such as Lünen, Beerse, Olen and Brixlegg, to several hundred semi-fabricators and cable makers. NACE 24.44 (copper production) employed 45,175 persons in 257 enterprises in 2024 (Eurostat 2026b); the International Copper Association reports about 50,000 direct jobs in the European copper industry (ICA 2023a). The largest groups are Aurubis (7,190 employees; 1,092 kt of cathode in fiscal year 2023/24, used in the refining table below, and 1,096 kt in 2024/25; about 1,098 kt in calendar 2024 from the first-quarter reports), KGHM Polska Miedź (588.7 kt of electrolytic copper in 2024), Boliden, Atlantic Copper, Wieland and KME, and the cable makers Prysmian and Nexans (Aurubis 2024; Aurubis 2025a; Aurubis 2025b; KGHM 2025a; Boliden 2025).

FIGURE 4 Main copper mines, smelters and refineries in the EU-27



Source: IGMNiR; company reports (KGHM, Aurubis, Boliden, Atalaya, Sandfire, Freeport-McMoRan, Wieland, KME, ElvalHalcor, TFKable, Prysmian); Reichl and Schatz (2026), World Mining Data; Commission Decision (EU) 2025/840 and European Commission, second list of strategic projects (9 October 2026); GISCO boundaries. Locations approximate; projects shown only where a location is published. Numbers refer to Annex C.

3.1 Mining

TABLE 7 Copper mine production in the EU-27 by Member State (kt Cu content)

Member State	2023	2024	Main mines, 2024 (kt)
Poland	395.4	400.1	KGHM: Lubin, Rudna, Polkowice-Sieroszowice
Spain	114.8	119.2	Riotinto (Atalaya) 46.2; MATSA (Sandfire) ≈55.1
Bulgaria	114.0	106.8	Assarel-Medet, Ellatzite-Med, Chelopech (Dundee) ≈13.5
Sweden	73.8	68.3	Aitik (Boliden) 59.8; Zinkgruvan 4.0
Portugal	40.9	54.2	Neves-Corvo (Lundin) 28.2; Aljustrel

Member State	2023	2024	Main mines, 2024 (kt)
Finland	20.1	26.4	Kevitsa (Boliden) 26.4
Romania	9.3	7.3	Roşia Poieni
Other	0.1	0.1	Germany, Slovakia
EU-27	**768.3**	**782.3**	

Source: Reichl and Schatz (2026), World Mining Data; mine data from company reports (KGHM 2025a; Boliden 2025; Atalaya 2025; Sandfire 2025; Lundin Mining 2025; Dundee 2025). Values marked ≈ are derived. For Bulgaria the 2023 values of World Mining Data (114.0 kt) and BGS (72.7 kt) differ. Company data: Chelopech 13.5 kt of copper in concentrate in 2024 (Dundee 2025); Assarel-Medet about 170 kt and Ellatzite-Med about 204 kt (2022) of concentrate at about 22% Cu, i.e. about 37 kt and 45 kt of copper (Asarel-Medet, undated; AmCham Bulgaria 2024) – together about 95 kt, between the two totals. CU-EU uses World Mining Data, which gives one consistent series for all Member States; the company-based value would lower EU mine output by about 12 kt and the extraction coverage ratio by less than 0.5 percentage points.

EU mine output equals 28% of refined copper used in the EU and 3.4% of world mine output (Reichl and Schatz 2026). The EU imported 3,500 kt of copper ores and concentrates (gross weight) from outside the EU in 2024 and exported 1,090 kt, almost entirely from Spain (596 kt) and Bulgaria (452 kt), with 36 kt from Romania (Comext, by reporter). Concentrate mined in Poland is smelted and refined by KGHM in Poland and is not exported (Polish extra-EU exports of 2603: 1.2 kt). The main supplier of imports was Brazil (23%), followed by Chile and Peru; the partner concentration index (HHI) was 1,520. Shares and HHI are computed over partners identified in the partner breakdown (3,470 kt), which excludes confidential and unallocated codes.

3.2 Smelting and refining

Refined copper production in the EU-27 is not published as an annual total; the table below compiles it from company reports and national statistics at about 2,300 kt for 2024 (BGS: 2,466 kt in 2023). CU-EU treats the total as uncertain (2,270–2,470 kt). Secondary refined copper is estimated bottom-up in copper content at 850 kt (750–950 kt): 158.6 kt refined from scrap by KGHM (KGHM 2025a), about 450–480 kt at Aurubis (recycled content of 44% in its cathode; Aurubis 2026), about 100 kt at the scrap-based refinery of Montanwerke Brixlegg, about 90 kt in Spain outside Atlantic Copper and in Italy, and about 30–45 kt of secondary feed at Harjavalta and Atlantic Copper; the secondary share of EU-28 refining was 20–40% in 1960–2014 (Ciacci et al. 2017). Boliden's Rönnskär smelter produced anodes but no cathode in 2024 after a fire in 2023.

TABLE 8 **Refined copper production in the EU-27 by producer, 2024 (kt)**

Producer	kt	Grade	Source
KGHM (PL), Głogów and Legnica	588.7	A	KGHM Management Board report 2024
Aurubis Hamburg and Lünen (DE)	505.0	A	Aurubis annual report 2023/24, fiscal year
Aurubis Olen and Beerse (BE)	358.0	A	Aurubis annual report 2023/24, fiscal year
Aurubis Pirdop (BG)	229.0	A	Aurubis annual report 2023/24, fiscal year
Atlantic Copper, Huelva (ES)	254.4	A	Freeport-McMoRan Form 10-K 2024
Boliden Harjavalta (FI)	159.0	B	Boliden year-end report 2024
Boliden Rönnskär (SE)	0.0	B	no cathode in 2024 after the 2023 fire
Montanwerke Brixlegg (AT)	100.0	C	Austria 2023 (BGS)
Other (ES, IT)	90.0	C	Spain other than Atlantic Copper and Italy, 2023 (BGS); mainly secondary
Total (model input)	**2,284**		

Source: company reports (KGHM 2025a; Aurubis 2024, fiscal year October 2023 – September 2024 – calendar 2024 about 6 kt higher (Aurubis 2025b); Freeport-McMoRan 2025; Boliden 2025), BGS (2025); IGMNiR compilation. Kovohuty (Krompachy, Slovakia), owned by Montanwerke Brixlegg, smelts scrap to about 48 kt of anode copper a year, which is refined to cathode at Brixlegg (UMCOR, undated); it is included in the Brixlegg value. The model uses 2,300 kt with a range of 2,270–2,470 kt. Grades: A official statistics or company financial statements, B company data, C derived.

3.3 Semis, castings and cables

TABLE 9 Production of copper semis, castings-related products and cables in the EU-27 (kt, gross weight)

PRODCOM	Product	2022	2023	2024	2024, EUR m
24442330	Wire rod (> 6 mm)	2,111	2,036	1,963	11,453
24442200	Bars, rods and profiles	1,391	916	903	4,251
24442400	Plates, sheets and strip	810	660	560	3,900
24442630	Tubes and pipes	388	329	314	3,141
24442500	Foil	32	42	45	633
24442100	Powders and flakes	20	24	20	255
24442350	Wire 0.5–6 mm	291	269	232	750
24442370	Wire ≤ 0.5 mm	81	100	76	600
24442650	Tube and pipe fittings	180	180	131	1,351
24441370	Unwrought copper alloys	396	378	387	1,720
24441330	Refined copper, unwrought	1,864	1,980	1,838	15,516
27321100	Winding wire	641	619	520	4,200
27321380	Conductors ≤ 1 kV	2,881	2,454	2,359	16,394
27321400	Conductors > 1 kV	1,006	1,090	1,244	7,758

Source: Eurostat PRODCOM (DS-059358), EU27_2020, sold production; values ending in round thousands are Eurostat estimates. Refined copper in PRODCOM is understated against company data because some national data are confidential. Cable weights include insulation and aluminium conductors.

3.4 Official statistics

TABLE 10 Structural business statistics for the activities of the copper value chain, EU-27, 2024

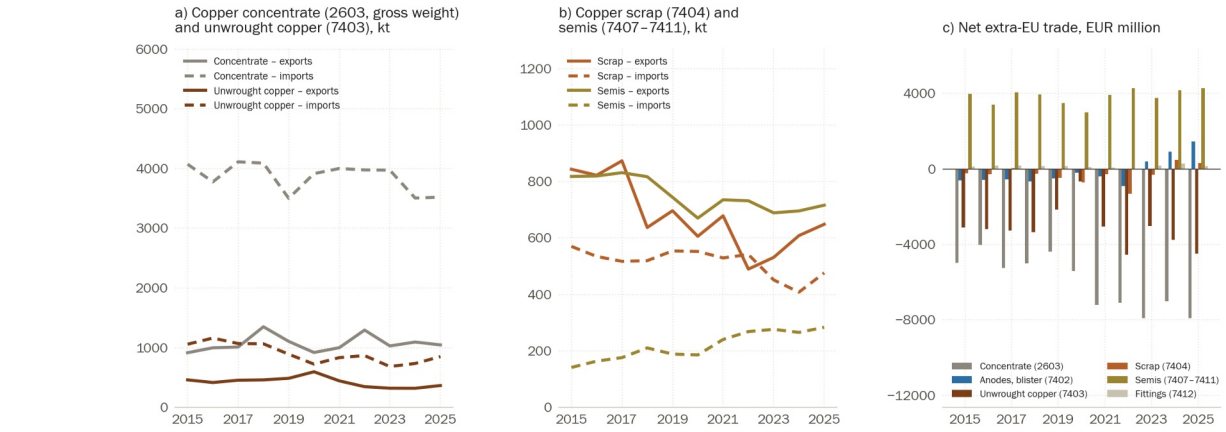
NACE	Activity	Turnover, EUR m	Output, EUR m	Value added, EUR m	Persons employed	Personnel costs, EUR m
B 07.29	Mining of other non-ferrous ores	12,686	11,740	6,586	43,634*	2,123*
G 46.77	Wholesale of waste and scrap	68,196	16,023	7,688	120,000	3,737
E 38.3	Materials recovery	90,000	80,000	18,000	273,002	10,668*
C 24.44	Copper production	60,000	54,785*	6,144	45,175	3,157
C 24.54	Casting of other non-ferrous metals	4,287	4,151	1,221	18,657	837
C 27.32	Other electronic and electric wires and cables	42,788	41,858	7,424*	95,000	4,662

Source: Eurostat SBS (sbs_ovw_act), EU27_2020; Eurostat rounds EU aggregates and suppresses confidential cells. * Estimate by IGMNiR (status E): B0729 EMP_NR: personnel costs / personnel cost per person in mining (NACE B); B0729 EXPN_SAL_BEN_MEUR: value added x personnel-cost share of 2022; C2444 VAL_OUT_MEUR: turnover x output/turnover ratio of 2022; C2732 AV_MEUR: sum of reporting member states, scaled by EU employment / employment of the reporting member states; E383 EXPN_SAL_BEN_MEUR: sum of reporting member states, scaled by EU employment / employment of the reporting member states.

Several EU aggregates are rounded by Eurostat (for example 24.44 turnover EUR 60,000 million, 38.3 output EUR 80,000 million, 46.77 employment 120,000); the gap-filled 24.44 output (EUR 54,790 million) is close to the sum of member states reporting output, scaled by employment (EUR 55,870 million). NACE 07.29 includes KGHM Polska Miedź with its mines, smelters and refineries: in Poland NACE 24.44 had only 7 enterprises, 229 persons employed and EUR 33 million of turnover in 2021, so KGHM is not classified there, and the EU value added of 07.29 (EUR 6,590 million) is far above the sum of the published member-state values (EUR 1,279 million). Employment in NACE 07.29 is not published for the EU and is estimated at about 43,600 persons from personnel costs; the KGHM group employed on average 31,607 persons in Poland in 2024, including subsidiaries outside mining (KGHM 2025a).

3.5 Trade with countries outside the EU

FIGURE 5 Extra-EU trade in copper by stage of processing, 2015–2025



Source: Eurostat Comext DS-045409, EU-27 extra-EU trade (gross weight); IGMNiR CU-EU.

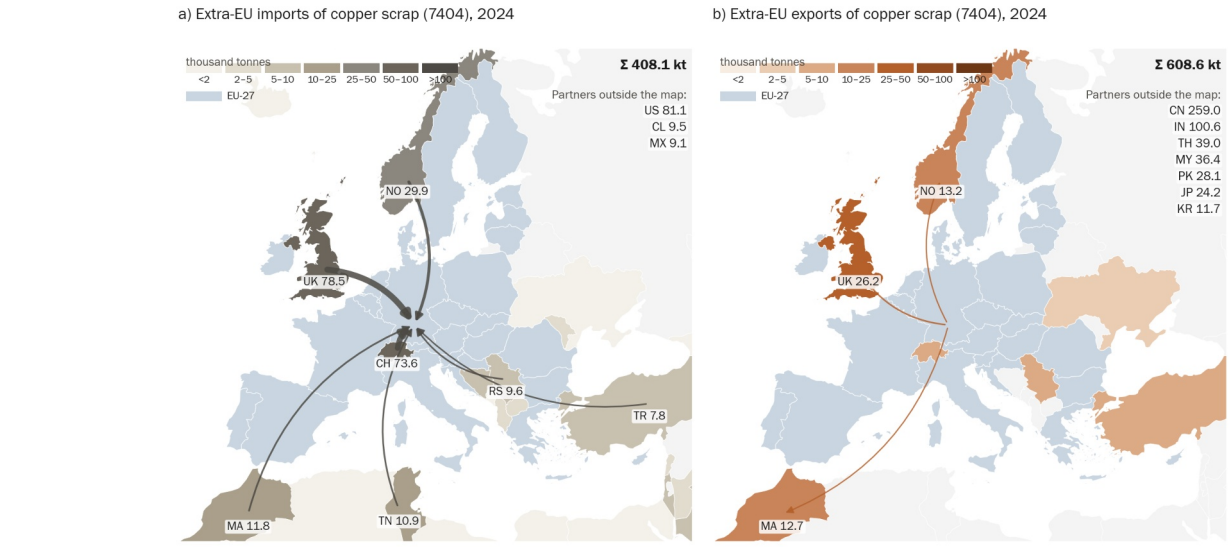
TABLE 11 Extra-EU trade in copper by product, 2024

CN	Product	Imports, kt	Exports, kt	Imports, EUR m	Exports, EUR m	Balance, EUR m
2603	Copper ores and concentrates	3,504.9	1,094.4	8,501	1,494	−7,008
7401	Copper mattes, cement copper	18.6	27.7	65	210	145
7402	Unrefined copper, anodes	49.0	127.1	573	1,493	919
7403	Refined copper and alloys, unwrought	735.3	320.2	6,356	2,594	−3,762
740311	– of which cathodes	711.1	243.2	6,102	2,058	−4,044
740321	– of which brass, unwrought	3.8	51.3	26	297	272
7404	Copper waste and scrap	408.1	608.4	2,669	3,155	486
7405	Master alloys of copper	0.7	2.6	7	28	21
7406	Copper powders and flakes	9.7	11.1	107	125	18
7407	Bars, rods and profiles	27.9	150.9	301	1,346	1,045
7408	Wire	85.7	331.1	819	3,072	2,253
7409	Plates, sheets and strip	69.6	117.3	662	1,352	690
7410	Foil	25.0	25.9	355	336	−18
7411	Tubes and pipes	57.5	70.4	606	805	199
7412	Tube and pipe fittings	49.9	35.1	712	995	283
7413	Stranded wire and cables, not insulated	45.3	19.9	465	234	−231

Source: Eurostat Comext (DS-045409), reporter EU27_2020, partner extra-EU; gross weight; intra-EU trade is not shown and Comext does not report copper contents. Unit values: concentrate imports EUR 2,426/t; scrap imports EUR 6,540/t and exports EUR 5,186/t, against an LME copper price of EUR 8,446/t.

The EU is a net importer of concentrate (EUR 7,010 million) and refined copper (EUR 3,760 million) and a net exporter of semis (EUR 4,170 million, mainly wire rod and wire) and fittings (EUR 280 million). Refined copper imports came mainly from Chile (38%; HHI 2,287). In copper scrap the EU exported 608.4 kt and imported 408.1 kt in 2024 (net exports 200.3 kt; 2023: 79.7 kt; 2025: 172.3 kt). 43% of exports went to China, followed by India and Thailand; imports came mainly from the United States, the United Kingdom and Switzerland. The unit value of exported scrap (EUR 5,186 per tonne) was lower than that of imported scrap (EUR 6,540 per tonne), which indicates lower grades in exports.

FIGURE 6 Origins of extra-EU copper scrap imports and destinations of exports, 2024



Source: Eurostat Comext (DS-045409), CN 7404, EU-27 extra-EU trade, gross weight; GISCO boundaries; IGMNiR CU-EU. EU-27 shown in light blue; partners outside the map are listed at the right.

3.6 Secondary feed and the recycling of copper

Secondary copper in the EU has two routes. Secondary smelters and refiners turn scrap and other recycling materials into cathode (850 kt). Semis producers and foundries melt clean scrap directly – brass mills, copper-strip and tube mills and some wire-rod plants. Direct melting is not reported by statistics; CU-EU derives it from a bridge: the copper contained in semis and castings less the refined copper that enters them (table below). With the central parameters the bridge gives 864 kt of copper from directly melted scrap, against 1,042 kt estimated for the EU-28 in 2014 (Passarini et al. 2018). The bridge is the difference of two quantities of about 3,000 kt and reacts strongly to the PRODCOM volumes: the same method gives about 930 kt for 2023 (refined output of 2,466 kt, BGS), and PRODCOM bars and profiles fell from 1,390 kt in 2022 to 920 kt in 2023. The Monte Carlo analysis therefore varies the PRODCOM volumes (−5% to +12%), refined output and the bridge term d_ref.

TABLE 12 Bridge from semis production to copper from direct melting, EU-27, 2024 (kt)

Item	PRODCOM	Gross, kt	Cu, %	Cu, kt	Status
Wire rod	24442330	1,963.2	100	1,963.2	O/E
Bars, rods and profiles	24442200	902.5	66	595.6	O/E
Plates, sheets and strip	24442400	560.0	85	476.0	O/E
Tubes and pipes	24442630	314.2	98	307.9	O/E
Foil	24442500	45.0	100	45.0	O/E
Copper in semis				**3,387.8**	E
Copper-alloy castings	24.54	200	75	150.0	E
less: apparent use of refined copper (production + net extra-EU imports)				−2,762.5	O/E
plus: refined copper in other uses (chemicals, powders, other)				60.0	E
plus: copper in net extra-EU exports of unwrought brass (CN 740321, 60% Cu)	740321	47.4	60	28.5	O/E
plus: bridge term d_ref (stock changes, uses not covered); central				0.0	E
Copper from scrap melted directly				**863.8**	E

Item	PRODCOM	Gross, kt	Cu, %	Cu, kt	Status
Excluded: unwrought alloys (intermediate), fittings and drawn wire (made from semis)		826		–	

Source: Eurostat PRODCOM 2024 and Comext; IGMNiR CU-EU. Net extra-EU imports of refined copper: CN 7403 less copper alloys (740321), 462.5 kt. Copper contents: bars and profiles 60–70%, strip 80–92%; castings tonnage 150–250 kt; scaling of PRODCOM volumes 0.95–1.12; refined output 2,270–2,470 kt; d_ref −80 to +80 kt. Powders are counted in other uses. All are varied in the Monte Carlo analysis, so direct melting is recomputed in every draw.

Secondary copper – 864 kt melted directly and 850 kt refined – requires about 1,785 kt of copper in scrap and other secondary materials. Net extra-EU exports of scrap contained about 69 kt of copper (imports at 80% and exports at 65% copper, derived from unit values), so the residual estimate of domestic scrap supply is 1,854 kt. The bottom-up estimate – old scrap recovered according to the dynamic model (1,480 kt) plus new scrap from fabrication (411 kt) – is 1,892 kt. The coverage ratio of domestic scrap supply to scrap used is 104% on the residual basis – by construction 1 plus net scrap exports relative to scrap used – and 106% on the bottom-up basis.

TABLE 13 Copper flows by node, EU-27, 2024 (kt Cu)

Node and flow	kt Cu	Status
1. Refined copper		
Refined copper production	2,300.0	O/E
– of which secondary	850.0	E
Net extra-EU imports of refined copper	462.5	O
Apparent use of refined copper	2,762.5	E
2. Semis and castings		
Copper from scrap melted directly (bridge)	863.8	E
Copper in semis and castings	3,537.8	E
3. Scrap		
Copper in secondary feed (refining and direct melting)	1,785.2	E
Net extra-EU imports of scrap, copper content (CN 7404)	−69.0	O/E
Domestic scrap supply, residual	1,854.2	E
Old scrap recovered (dynamic model)	1,480.4	M
New scrap (13% of copper in semis used in the EU and castings)	411.3	E
Domestic scrap supply, bottom-up	1,891.7	M
Unaccounted-for copper (residual less bottom-up)	**−37.5**	M
4. Copper in use		
Inflow to use	2,852.7	M
End-of-life outflow	2,594.4	M
Stock in use, Mt	71.3	M

Source: IGMNiR CU-EU v1.1, modules M2 and M2b. Status: O observation, E estimate, M model result. Recovery 95% in refining and 97% in direct melting.

The residual and the bottom-up estimates differ by −38 kt (residual less bottom-up; 90% band −287 to 328 kt). This small difference is not an independent confirmation of the model: the bottom-up estimate rests on two calibrated parameters, the scaling of collection and recovery rates (1.10) and the new-scrap rate (13%), and the second is about half of the 25% estimated by JRC for the EU-28 in 2014 (Passarini et al. 2018). With a new-scrap rate of 25%, new scrap would be about 790 kt instead of 410 kt, and the balance would close only with old-scrap recovery of about 1,060 kt instead of 1,480 kt – an end-of-life recycling rate of about 41% instead of 57%. The data used do not discriminate between these two pictures. The central value and the median of the draws have opposite signs because several parameter ranges are asymmetric about their modal values (semis volume scaling, refined output, collection scaling); the residual is not distinguishable from zero and its sign is not interpreted. Copper also leaves the EU in forms not classified as copper scrap – indicatively about 25–45

kt in exported ferrous scrap (0.15–0.25% Cu) and 25–40 kt in exported aluminium scrap (2–3% Cu), plus used vehicles and electrical equipment. The table below shows how far the residual moves across the parameter ranges.

TABLE 14 Reconciliation of unaccounted-for copper: change by parameter (kt Cu)

Parameter	Range	At low value	At high value
pc_scale	0.95–1.12	−152.6	366.3
the per-capita inflow of copper into use	0.85–1.15	217.3	−217.3
the end-of-life collection rates	0.95–1.20	201.9	−134.6
secondary refined copper	750.00–950.00	−105.3	105.3
R_total	2,270.00–2,470.00	30.9	−175.3
the rate of new scrap	0.10–0.16	94.9	−94.9
the bridge term for direct melting	−80.00–80.00	−82.5	82.5
product lifetimes	0.80–1.20	−60.5	87.4

Source: IGMNiR CU-EU v1.1; one parameter at a time, other parameters central (central residual −37.5 kt). Not covered by parameters: copper exported in used goods, vehicles and mixed scrap outside CN 7404, and stock changes at scrap dealers.

TABLE 15 CU-EU and published copper flow studies for the EU

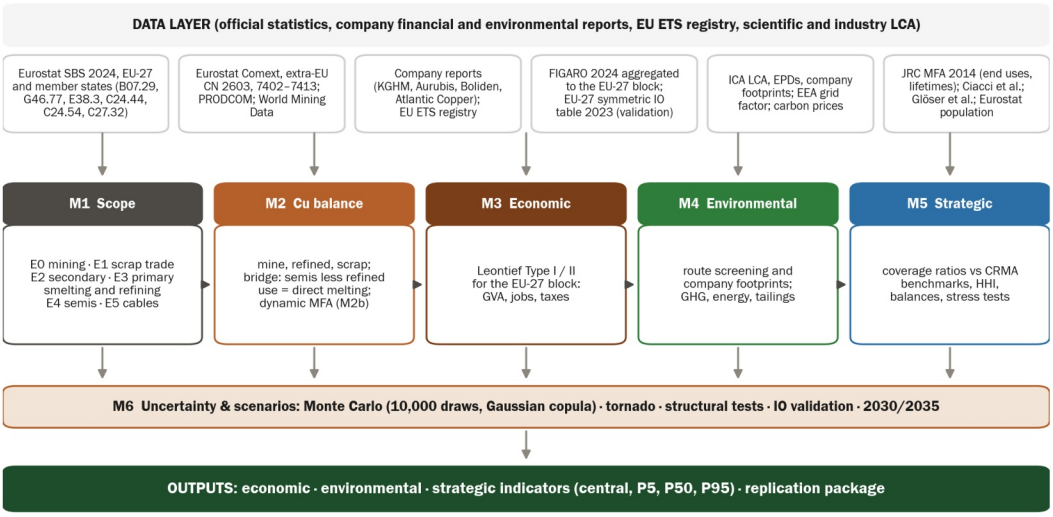
Indicator	CU-EU 2024	Published value	Source
Apparent use of refined copper, kt	2,762	2,196 (EU-28, 2014)	Passarini et al. (2018)
Copper from direct melting, kt	864	1,042 (EU-28, 2014)	Passarini et al. (2018)
Stock in use, kg per person	158	≈140; 160–200; ≈160	Passarini et al. (2018); Ciacci et al. (2017); Soulier et al. (2018)
End-of-life recycling rate, %	57	61; ≈60	Passarini et al. (2018); Ciacci et al. (2017)
New scrap, % of copper in semis and castings used	13	25 (EU-28, 2014); 28 of demand	Passarini et al. (2018); ICA (2023a)
Secondary share of copper first use, %	47	55 (27 end-of-life + 28 fabrication scrap); ≈50 (2005–2014)	ICA (2023a); Soulier et al. (2018)

Source: IGMNiR CU-EU v1.1 and the studies named. The published studies refer to the EU-28 (with the United Kingdom) and to 2014 or 2005–2014; their definitions of first use and recycling input differ (the 55% includes internal fabrication scrap). Refined copper use in Passarini et al. (2018) is the modelled input of refined copper to EU-28 fabrication in 2014; CU-EU uses apparent use (production plus net extra-EU imports) in 2024, and the difference between the two is not reconciled here. The agreement of the stock in use and of the end-of-life recycling rate is not an independent validation: the dynamic model of CU-EU takes its inflow profile, end-use shares and lifetimes from Ciacci et al. (2017) and Passarini et al. (2018) and its collection rates from Glöser et al. (2013), scaled to the European level.

04 The CU-EU model

CU-EU applies the architecture of IGMNiR's integrated models for non-ferrous metals to the EU-27 as one economy: deliveries between member states are treated as domestic, trade with countries outside the EU as foreign trade. It links six modules: scope and allocation (M1), a copper mass balance with a dynamic model of copper in use (M2 and M2b), an input-output model of economic and fiscal effects for the EU block (M3), an environmental module with route-level screening values (M4), strategic indicators and stress tests (M5) and an uncertainty and scenario module (M6). A replication script recomputes value added and employment from the published package files, and a quality-control script compares the key numbers of the English and Polish versions.

FIGURE 7 Architecture of the CU-EU model



Source: IGMNiR.

4.1 Scope and segments

All six segments are built from Eurostat structural business statistics (SBS) for the EU-27 in 2024. **E0** is the copper share (75%) of NACE 07.29 (mining of other non-ferrous metal ores). KGHM, the largest copper producer in the EU, operates its mines, concentrators, smelters and refineries within one enterprise; the confidentiality pattern of the SBS shows that it is classified to mining, so its smelting and refining (588.7 kt of cathode in 2024) is part of E0. **E1** is the copper share of wholesale of waste and scrap (NACE 46.77; 20% of value, 12% of employment) and of materials recovery (38.3; 5% and 4.5%). **E2** and **E3** are the smelting and refining part of copper production (NACE 24.44): its share (21%) follows the employment of the smelters and refineries classified to 24.44, and it is split by the secondary share of their refined output (40.4%, computed from the balance as secondary refined copper less KGHM's copper from scrap, over refined output less KGHM). Their output is valued physically – refined output outside KGHM (1,711 kt) at the LME price (EUR 8,446/t) plus 10% for by-products and refining margins, EUR 15,900 million or 29% of the output value of 24.44 – while their value added, employment and personnel costs follow sm_share. **E4** is the rest of 24.44 (semis, wire rod, alloys) plus

the copper-alloy share (40%) of non-ferrous foundries (24.54). **E5** is the copper-conductor share (75%) of wires and cables (27.32). The recycling chain comprises E1 and E2; the copper industry E0–E4; the extended value chain E0–E5. Copper from scrap melted directly by semis producers is part of E4 and is reported separately in proportion to its share of copper input.

TABLE 16 Segments of the CU-EU model, 2024 (central estimate)

Segment	Basis	Output, EUR m	GVA, EUR m	Persons	GVA per person, EUR k
E0 Mining of copper ores (incl. KGHM smelting)	SBS 07.29 × copper share	8,805	4,940	32,730	150.9
E1 Collection and trade of copper scrap	SBS 46.77, 38.3 × copper shares	7,205	2,438	26,690	91.3
E2 Secondary smelting and refining	SBS 24.44 × sm_share × phi_ref; output valued physically	6,424	521	3,830	136.0
E3 Primary smelting and refining	SBS 24.44 × sm_share × (1 − phi_ref); output valued physically	9,475	769	5,650	136.0
E4 Semis and copper-alloy castings	SBS 24.44 less E2–E3 + 24.54 × cu_cast	40,547	5,343	43,150	123.8
E5 Copper in wires and cables	SBS 27.32 × cu_cable	31,393	5,568	71,250	78.1

Source: IGMNiR CU-EU v1.1; Eurostat SBS (sbs_ovw_act) 2024, EU27_2020. GVA at factor cost. Status E (estimate) for all segments. Figures are rounded; totals may differ from the sum of components.

Eurostat publishes EU-27 aggregates of the SBS rounded and with confidential cells. Missing 2024 cells were completed: output of 24.44 from turnover and the output-to-turnover ratio of 2022; value added of 27.32 and personnel costs of 38.3 from the sum of member states, scaled by the ratio of EU to member-state employment; personnel costs of 07.29 from value added and the personnel-cost share of 2022; employment of 07.29 from personnel costs and the cost per person of mining (NACE B). Cells published in rounded form are used as published. The table lists every cell used and its status.

4.2 Copper mass balance

The physical module works in kilotonnes of copper. Refined output of the EU-27 (2,300 kt in 2024; range 2,270–2,470 kt) is compiled from company reports, USGS and BGS (Chapter 3), because the PRODCOM figure for refined copper is incomplete. Apparent use of refined copper is refined output plus net extra-EU imports of refined copper (CN 7403 less unwrought alloys; 462 kt), 2,762 kt. Copper from scrap melted directly by semis producers and foundries (S_dm, 864 kt) is derived in every Monte Carlo draw from a bridge: copper contained in semis (3,388 kt; PRODCOM volumes times copper contents, scaled by pc_scale, 0.95–1.12, for rounded cells and incompletely recorded production; metal powders excluded) and in copper-alloy castings (150 kt), less refined copper entering them (apparent use less 60 kt of other uses), plus copper in net extra-EU exports of unwrought copper alloys (CN 740321 at 60% copper, 28.5 kt), which are melted from scrap outside the semis, and a term d_ref (−80 to +80 kt) for stock changes and uses not covered. Secondary copper S – copper from old and new scrap – is secondary refined copper (850 kt; range 750–950 kt) plus S_dm, 1,714 kt. Copper in secondary feed C follows from S and recovery rates (1,785 kt). The residual domestic scrap supply A_res is C less net extra-EU imports of copper in scrap; the bottom-up supply A_bu is old scrap recovered (dynamic model) plus new scrap from fabrication (13% of copper in semis used in the EU – production less net extra-EU exports – and in castings).

$$S_dm = \text{Cu in semis} + \text{Cu in castings} - (\text{refined use} - \text{other uses}) + \text{Cu in net exports of 740321} + d_ref \qquad A_res = C - cu_imp \cdot M_{7404} + cu_exp \cdot X_{7404} \qquad A_bu = \text{old scrap recovered} + r_new \cdot (\text{Cu in semis} - \text{net exports} + \text{Cu in castings})$$

4.3 Dynamic model of copper in use

The dynamic model follows copper entering use in the EU-27 from 1960 to 2035 (with a spin-up from 1900) and releases it at end of life with normally distributed product lifetimes. The inflow is anchored at the per-capita inflow of the EU-28 in 2014 estimated by the JRC (5.91 kg per person, derived from the JRC estimate of copper entering use and the population of the EU-28; Passarini et al. 2018) times k_in, and shaped by the per-capita copper supply of the EU-28 (apparent refined use plus direct melting) from Ciacci et al. (2017) for 1960–2010; 2014 is set equal to 2010. The 2024 level is derived from the CU-EU balance: copper in semis used in the EU (production less net extra-EU exports of semis and fittings, 415 kt gross at 90% copper) and in castings, less new scrap (13%), plus net imports of copper in finished products (100 kt; JRC 2014: +225 kt), 2,853 kt. End-use shares and lifetimes are those of the JRC; collection and recovery rates by waste stream follow Glöser et al. (2013), scaled by 1.10 to the European level of end-of-life recycling of about 60% (Ciacci et al. 2017).

TABLE 17 Parameters of the dynamic model of copper in use: end uses

End use	Share of inflow, %	Mean life, years	SD, years	Collection, %	End-of-life recycling rate, %
Buildings and construction	34	40	12.0	79	72
Electrical and electronic equipment	29	25	7.5	73	51
Industrial machinery	20	18	5.4	75	55
Transport	9	16	4.8	74	54
Consumer and general products	8	8	2.4	69	37

Source: Passarini et al. (2018), Annex Table S11 (shares and lifetimes); Glöser et al. (2013), Table 1 (collection and recovery by waste stream), except collection in transport (67%, the JRC rate for end-of-life vehicles; Passarini et al. 2018), scaled by coll_scale; IGMNiR CU-EU v1.1. The end-of-life recycling rate is the copper recovered as a share of copper in end-of-life products and includes collection; the processing yield of collected scrap is the ratio of the last two columns.

TABLE 18 Parameters of the dynamic model: inflow

Parameter	Value	Source
Anchor: EU-28 inflow per person, 2014	5.91 kg	derived from Passarini et al. (2018)
Scaling for the EU-27 (k_in)	1.00 (0.85–1.15)	IGMNiR
Inflow index 1960 (r60)	0.67 (0.55–0.80)	Ciacci et al. (2017)
Inflow index 1970 / 1980 / 1990 / 2000 / 2010	0.75 / 0.98 / 0.96 / 1.21 / 1.00	Ciacci et al. (2017)
Inflow to use 2024, kt	2,853	CU-EU balance
Growth of inflow per person 2025–2035	1.0% (0.0–2.5%)	IGMNiR
Population 1960 / 2024 / 2035, million	354.5 / 450.1 / 452.0	Eurostat demo_gind, proj_23np
Collection and recovery scaling (coll_scale)	1.10 (0.95–1.20)	Ciacci et al. (2017); Soulier et al. (2018)

Source: IGMNiR CU-EU v1.1. The EU-28 index includes the United Kingdom; it shapes the path of per-capita inflow, while the level is set by the anchor and by the 2024 balance.

4.4 Economic, fiscal, environmental and strategic modules

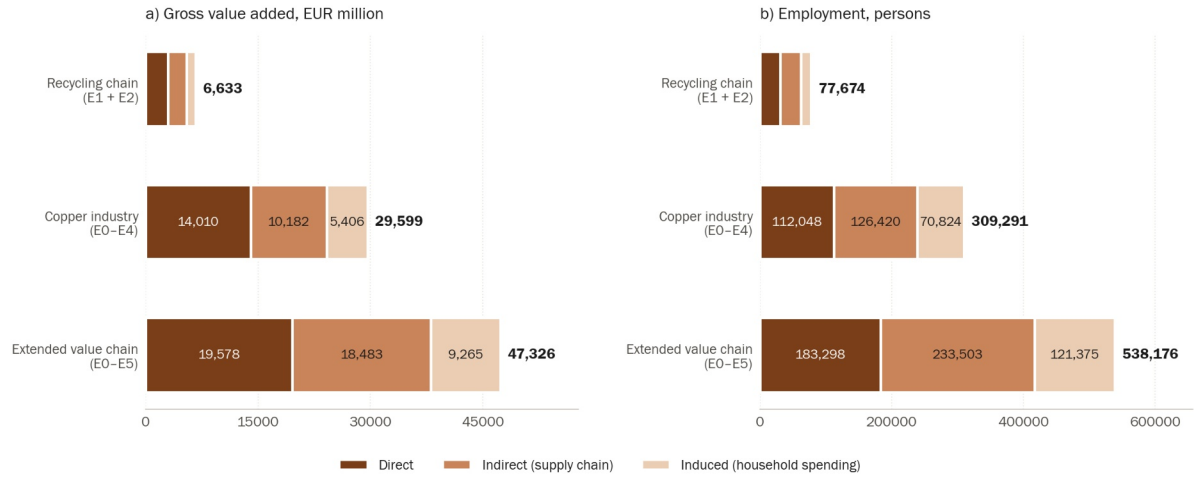
Indirect and induced effects are computed with Leontief Type I and Type II multipliers of the EU block of the Eurostat FIGARO inter-country table for 2024 (64 products; Eurostat 2026a), aggregated from the 27 destination countries: intra-EU deliveries are domestic, and only purchases from outside the EU are treated as imports. Households are closed with a propensity to consume of 0.86 out of net labour income and the implicit tax rate on labour of the EU-27 (37.09%; DG TAXUD 2026). Purchases within the chain – ores, concentrates, scrap, metal – are removed from the first-round demand; the remaining intermediate consumption is spread

over non-chain products with the parent column of FIGARO. Employment coefficients relate 2024 employment by industry from national accounts to the output of the table; where 2024 is published only for the NACE section, the 2023 detail is scaled by the 2023–2024 change of its section. Applied to the output of FIGARO the coefficients reproduce 219.4 million of 219.4 million persons employed in the EU-27 (a construction check, not a validation). As an independent check the model is re-run with the EU-27 symmetric input-output table of Eurostat for 2023 (section 5). Direct value added is at factor cost (SBS), indirect and induced value added at basic prices (FIGARO). Taxes are model estimates: labour taxes with the implicit tax rate, corporate income tax at an average statutory rate of 21.8% on a taxable share of operating surplus, and net taxes on production and products from FIGARO, plus the Polish mineral extraction tax paid by KGHM (EUR 810 million beyond the average production taxes of mining). The environmental module compares secondary copper produced in the EU with one-for-one substitution of global average primary cathode; strategic indicators use Comext extra-EU trade by partner. Uncertainty is propagated by a Monte Carlo simulation of 10,000 draws from triangular distributions of all parameters in Annex B, with correlated groups linked by a Gaussian copula.

05 Economic and fiscal contribution

In 2024 the extended copper value chain in the EU-27 generated EUR 19,580 million of direct gross value added and employed about 183,300 persons. Domestic suppliers within the EU added EUR 18,480 million and about 234,000 jobs (Type I: EUR 38,060 million, 90% band 34,400–41,190), and household spending of wages a further EUR 9,270 million (Type II: EUR 47,330 million). The value-added multiplier is 1.94 (Type I) and 2.42 (Type II). The copper industry without cables (E0–E4) accounts for EUR 14,010 million of direct value added, the recycling chain (E1, E2) for EUR 2,960 million. The largest segment by value added is E5 Copper in wires and cables.

FIGURE 8 Economic footprint of the copper value chain in the EU-27, 2024



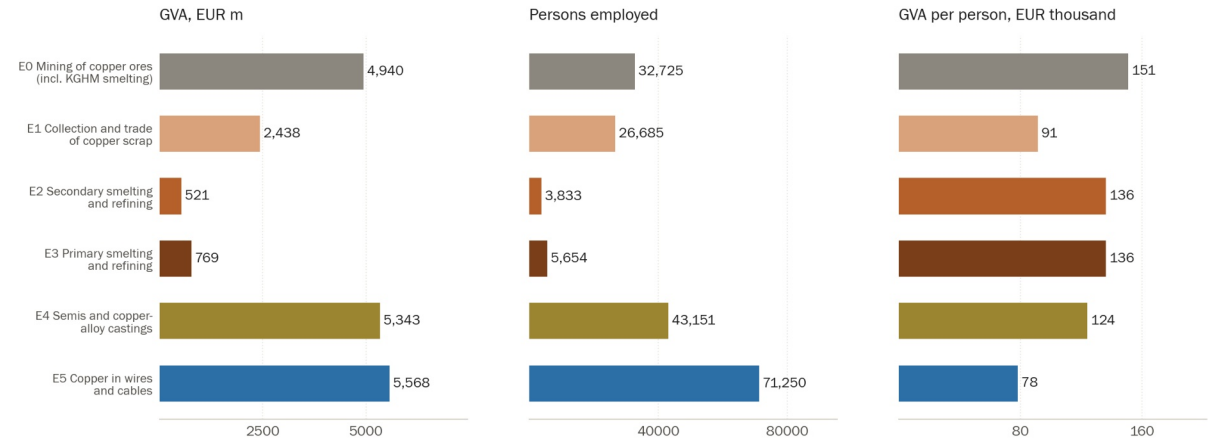
Source: IGMNiR CU-EU v1.1; Eurostat SBS 2024, PRODCOM 2024, FIGARO 2024 (EU-27 block), Comext; central estimate.

TABLE 19 Economic contribution by segment, 2024 (central estimate)

Segment	GVA direct, EUR m	GVA Type I	GVA Type II	Jobs direct	Jobs Type I	Taxes, EUR m
E0 Mining of copper ores (incl. KGHM smelting)	4,940	6,808	8,038	32,730	56,100	2,695
E1 Collection and trade of copper scrap	2,438	4,609	5,595	26,690	54,400	1,438
E2 Secondary smelting and refining	521	833	1,038	3,830	7,600	299
E3 Primary smelting and refining	769	1,228	1,531	5,650	11,300	442
E4 Semis and copper-alloy castings	5,343	10,714	13,397	43,150	109,000	3,630
E5 Copper in wires and cables	5,568	13,869	17,728	71,250	178,300	4,898
Recycling chain (E1–E2)	2,959	5,442	6,633	30,520	62,100	1,738
Copper industry (E0–E4)	14,010	24,192	29,599	112,050	238,500	8,505
Extended value chain (E0–E5)	19,578	38,061	47,326	183,300	416,800	13,403

Source: IGMNiR CU-EU v1.1. Direct copper from scrap melted in semis (part of E4, in proportion to its share of copper input, 24%): EUR 1,300 million of GVA and about 10,500 persons. Taxes exclude VAT.

FIGURE 9 Direct GVA, employment and productivity by segment, 2024



Source: IGMNiR CU-EU v1.1; Eurostat SBS 2024, PRODCOM 2024, FIGARO 2024 (EU-27 block), Comext; central estimate.

Value added per person ranges from EUR 78 thousand to EUR 151 thousand. Mining with integrated smelting (E0) has the highest value added per person, because the copper and silver of KGHM are extracted from own ore. The employment of the segments can be compared with the reported headcount of companies and with industry statistics; the comparison shows orders of magnitude, since company headcounts include activities and countries outside the segment definitions.

TABLE 20 Reconciliation of employment with official, company and industry data, 2024

Item	Persons	Status	Source
SBS NACE 24.44, EU-27 (persons employed)	45,175	O	Eurostat SBS
Model: smelting and refining in 24.44 (E2 + E3)	9,490	E	CU-EU
Aurubis smelting and recycling sites in the EU (Hamburg incl. head office, Lünen, Pirdop, Olen, Beerse, Berango), 30 Sep 2025	5,922	O	Aurubis (2025a)
Atlantic Copper, Huelva (2023); Montanwerke Brixlegg	739; 337	O/E	company data; press
Model: semis and castings (E4)	43,150	E	CU-EU
Wieland (group, FY 2023/24); KME SE (2024); ElvalHalcor copper segment (2024); Diehl Metall (2024)	10,515; 3,159; 1,861; 2,882	O	company reports
Model: mining incl. KGHM smelting (E0)	32,730	E	CU-EU
NACE 07.29, EU-27 (estimated persons employed); KGHM average employment in Poland, 2024	43,600; 31,607	E/O	SBS (completed); KGHM (2025a)
Model: copper industry E0–E4 (direct)	112,000	E	CU-EU
Direct jobs in the European copper industry reported by the industry	≈50,000	O	ICA (2023a)
Model: cables (E5) vs SBS 27.32	71,200 / 95,000	E/O	CU-EU; Eurostat SBS

Source: IGMNiR CU-EU v1.1; company reports as stated (Aurubis 2025a; Wieland-Werke 2024; KME Group 2025; Viohalco 2025 for ElvalHalcor; Diehl 2025; KGHM 2025a). Company headcounts include sites outside the EU (Wieland, Diehl) and activities outside copper; the industry figure has no stated scope (mining, smelting and refining, semis are likely included, cables not). The model E0–E4 includes collection and trade of scrap and is therefore larger than an industry-only count.

TABLE 21 Results of the IGMNiR copper models for the EU-27, Germany, Italy and Poland, 2024 (central values)

Indicator	CU-EU	CU-DE	CU-IT	CU-PL
Direct GVA, extended chain, EUR m	19,578	4,071	1,811	3,085
GVA Type I, EUR m	38,061	6,328	3,353	4,401
Direct employment, persons	183,300	41,400	16,900	27,900
Jobs Type I, persons	416,800	65,600	36,200	53,000
Taxes and contributions, EUR m	13,403	2,410	1,120	2,347

Indicator	CU-EU	CU-DE	CU-IT	CU-PL
Secondary copper, kt Cu	1,714	459	324	167
GHG potentially avoided, kt CO_2e	5,129	1,281	1,059	441
Copper stock in use, kg per person	158	164	161	–

Source: IGMNiR CU-EU v1.1; CU-DE (IGMNiR 2026a), CU-IT (IGMNiR 2026b), CU-PL (IGMNiR 2026c). The national models use national input-output blocks, in which purchases from other member states are imports; the EU model treats them as domestic, so its multipliers are higher and its totals are not the sum of national results. The emission results of the models use their own definitions of secondary copper and their own screening values and are not additive. A dash means that the model does not report the indicator under the same definition.

The input-output results depend on how first-round purchases are separated from the chain and on the table used. The table shows the sensitivity of value added and employment including the supply chain to the main construction choices; the variant that keeps the domestic part of metal purchases in the first round double-counts flows within the chain and is shown only as an upper bound.

TABLE 22 Sensitivity of the input-output results to construction choices, 2024

Variant	GVA direct, EUR m	GVA Type I, EUR m	Multiplier	Jobs Type I
Central case (FIGARO 2024, EU block)	19,578	38,061	1.94	416,800
Supply-chain effects −20%	19,578	34,364	1.76	370,100
Supply-chain effects +20%	19,578	41,758	2.13	463,500
EU-27 symmetric IO table of Eurostat, 2023	19,578	38,259	1.95	417,200
Conservative first round (metal products, electronics, electrical equipment and machinery also excluded)	19,578	33,794	1.73	361,600
E1 first round from all SBS intermediate consumption	19,578	38,461	1.96	422,000
Value added at basic prices for all segments	19,890	38,373	1.93	416,800
Domestic metal purchases kept in first round (upper bound)	19,578	69,081	3.53	775,700

Source: IGMNiR CU-EU v1.1.

FIGARO is a Eurostat construction that balances national tables against bilateral trade; as an independent check the model was re-run with the symmetric input-output table that Eurostat compiles for the EU-27 as a whole (naio_10_cp1700, 2023, product by product, basic prices). Value added including the supply chain changes by 0.5% (EUR 38,260 million), jobs including the supply chain by 0.1%, and Type II value added by less than 0.1%. The multipliers of the products used by CU-EU are compared in the table.

TABLE 23 Multipliers from FIGARO 2024 (EU block) and the EU-27 symmetric input-output table 2023

Product	GVA I FIGARO	GVA I SIOT	GVA II FIGARO	GVA II SIOT	Jobs I FIGARO	Jobs I SIOT
Mining and quarrying (B)	1.84	1.86	2.24	2.24	2.02	2.03
Wholesale trade (G46)	1.82	1.81	2.28	2.25	1.94	1.96
Waste collection, treatment, recovery (E37–39)	2.09	2.15	2.63	2.69	2.37	2.38
Basic metals (C24)	3.60	3.59	4.57	4.50	3.83	3.93
Fabricated metal products (C25)	2.21	2.23	2.84	2.83	1.94	1.98
Electrical equipment (C27)	2.44	2.44	3.13	3.09	2.37	2.43
CU-EU extended value chain	1.94	1.95	2.42	2.42	2.27	2.28

Source: Eurostat (2026a), naio_10_fcp_ip4 (FIGARO, 2024, aggregated to the EU-27) and naio_10_cp1700 (EU27_2020, 2023); IGMNiR CU-EU v1.1. Product multipliers relate total to direct value added or jobs of one euro of final demand; the chain row relates the model totals to direct values.

The table shows, for each segment, how intermediate consumption is divided between purchases within the copper chain (ores, concentrates, scrap, metal), which are excluded from the first round to avoid double counting, and other inputs, of which the part produced in the EU enters the input-output model.

TABLE 24 Intermediate consumption and first-round demand by segment, 2024 (EUR million)

Segment	Output	Intermediate consumption	Chain inputs (excluded)	Other inputs	of which from the EU (first round)	Indirect GVA
E0 Mining of copper ores (incl. KGHM smelting)	8,805	3,865	1,321	2,544	2,281	1,869
E1 Collection and trade of copper scrap	7,205	4,767	2,006	2,761	2,568	2,172
E2 Secondary smelting and refining	6,424	5,902	5,460	442	387	311
E3 Primary smelting and refining	9,475	8,706	8,054	652	570	459
E4 Semis and copper-alloy castings	40,547	35,204	27,572	7,632	6,671	5,371
E5 Copper in wires and cables	31,393	25,825	13,499	12,326	10,160	8,301
Total	103,848	84,270	57,912	26,358	22,638	18,483

Source: IGMNiR CU-EU v1.1. Chain inputs of E2–E5 = metal share of output (m3, m4, m5) or of E0 = m0; for E1 = intermediate consumption less non-chain inputs of the parent FIGARO column.

TABLE 25 Supply-chain value added by supplying product, extended value chain, 2024

Supplying product (CPA)	GVA, EUR m	Share, %
M69_70 Legal, accounting and management consultancy services	1,346	7.3
D35 Electricity, gas, steam and air conditioning	1,230	6.7
C25 Fabricated metal products	985	5.3
L Real estate services	940	5.1
H49 Land transport and pipelines	933	5.1
C27 Electrical equipment	899	4.9
N80-82 Security, building and office support services	808	4.4
H52 Warehousing and transport support	711	3.8
G46 Wholesale trade	709	3.8
J62_63 Computer programming and information services	653	3.5
Other products	9,267	50.1

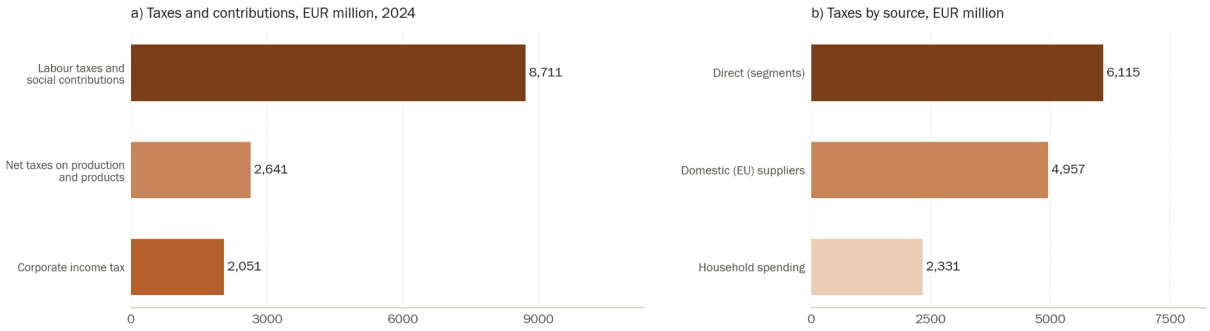
Source: IGMNiR CU-EU v1.1; FIGARO 2024, EU block.

All economic results are gross contributions: they describe the value added and employment linked to the activity in 2024, not what would be lost if the activity stopped, since part of the labour, capital and demand would move to other uses and part of the supply would be replaced by imports. The model does not quantify such a counterfactual; the only reduction it quantifies is the stress scenario S3 (Chapter 10).

5.1 Taxes, public revenue and public support

Activity in the extended chain is associated with about EUR 13,400 million of taxes and social contributions excluding VAT (90% band 12,080–14,570): EUR 6,120 million in the segments, EUR 4,960 million at domestic suppliers and EUR 2,330 million from household spending. Labour taxes and contributions account for EUR 8,710 million. Net taxes on production include the Polish mineral extraction tax paid by KGHM, EUR 810 million beyond the average production taxes of mining (KGHM 2025a; IGMNiR 2026c). The implicit tax rate on labour (37.09%) is a macroeconomic rate applied to the personnel costs of the SBS; actual payments by member state, firm and wage level are not observed, and the effective corporate tax rate of the firms is not known. The total is an attribution of public revenue to the activity, not a net fiscal balance.

FIGURE 10 Taxes and contributions linked to the copper value chain, 2024



Source: IGMNiR CU-EU v1.1; implicit tax rate on labour, EU-27 2024 (DG TAXUD); FIGARO 2024 (EU-27 block). Model estimates attributing public revenue to the activity; VAT excluded; not a net fiscal balance. Compensation of indirect emission costs is not shown.

TABLE 26 Taxes, contributions and public support by category, 2024 (EUR million)

Category	EUR m	Status	Basis
(i) Labour taxes and social contributions	8,711	M	37.09% × labour cost (SBS, FIGARO)
(ii) Corporate income tax	2,051	M	21.8% × taxable share of operating surplus
(iii) Net taxes on production and on products used, net of other subsidies	2,641	M	FIGARO coefficients; KGHM mineral extraction tax
of which: Polish mineral extraction tax of KGHM, beyond average production taxes of mining	811	E	KGHM (2025a); IGMNiR (2026c)
Total (excl. VAT)	13,403	M	
Indirect emission cost compensation, all sectors, paid by 15 member states in 2024 (costs of 2023)	5,520	O	European Commission (2025d); not netted
of which copper in Germany, cost year 2024 (≈1.9% of EUR 2,784 m)	≈53	E	DEHSt (2026)
of which KGHM in Poland, cost year 2024 (PLN 151.9 m at PLN 4.306 per EUR)	≈35	O	IGMNiR (2026c); ECB

Source: IGMNiR CU-EU v1.1; DG TAXUD (2026); European Commission (2025d), Carbon Market Report COM(2025) 735; DEHSt (2026); IGMNiR (2026c). Copper production (NACE 24.44) is eligible for the compensation of indirect emission costs (Guidelines 2020/C 317/04, amended by C/2026/196, European Commission 2026b, with an aid intensity of 80%); copper-specific amounts are known only for Germany and for KGHM. Compensation is a public expenditure and is not deducted from the taxes. Free allocation of emission allowances to the named installations is recorded in the Union Registry and is not quantified here; at the 2024 auction price of EUR 64.74 per allowance, each million allowances allocated free of charge corresponds to EUR 64.7 million. The direct taxes of the segments alone (excluding the supply chain and induced effects) are EUR 6,120 million.

5.2 Split keys and boundaries with other IGMNiR reports

Three keys allocate statistics to copper: the copper share of mining (cu_mine, 75%), the smelting-and-refining share of NACE 24.44 (sm_share, 21%) and the secondary share of the output of these smelters (40.4%). The keys move value added between segments rather than in or out of the chain, except the mining share. The table shows their effect on the recycling chain and on the extended chain.

TABLE 27 Alternative split keys, 2024 (EUR million)

Key	GVA E1+E2	GVA E1+E2 Type I	GVA E0	GVA E2	GVA E3	GVA E0–E5
Central keys	2,959	5,442	4,940	521	769	19,578
Smelting share 16%	2,835	5,405	4,940	397	586	19,578
Smelting share 27%	3,108	5,486	4,940	670	989	19,578
Secondary refined copper 750 kt	2,883	5,321	4,940	446	844	19,578
Secondary refined copper 950 kt	3,034	5,562	4,940	597	694	19,578
Copper share of mining 62%	2,959	5,442	4,083	521	769	18,722
Copper share of mining 85%	2,959	5,442	5,598	521	769	20,237

Key	GVA E1+E2	GVA E1+E2 Type I	GVA E0	GVA E2	GVA E3	GVA E0–E5
Scrap trade valued with the employment key	2,254	4,198	4,940	521	769	18,873

Source: IGMNiR CU-EU v1.1.

CU-EU covers the whole EU-27 and therefore contains the activities analysed in the national IGMNiR reports on copper in Poland, Germany and Italy and the copper part of the report on non-ferrous scrap in Poland. Within CU-EU each activity is counted once: KGHM appears only in E0, the smelters classified to 24.44 only in E2 and E3, semis and castings only in E4. The national reports and CU-EU are alternative perspectives and are not additive.

TABLE 28 Boundaries with other IGMNiR reports

Activity	CU-EU	Other IGMNiR report	Treatment
KGHM: mines, concentrators, smelters, refineries, wire rod	E0	CU-PL	E0 in CU-EU; segments of CU-PL
Aurubis Hamburg and Lünen	E2, E3	CU-DE	company accounts in CU-DE; SBS key in CU-EU
Brass mills, wire rod and cables in Italy	E4, E5	CU-IT	national SBS in CU-IT; EU SBS in CU-EU
Scrap trade and recovery in Poland	E1	NF-REC-PL	copper part only

Source: IGMNiR (2026a, 2026b, 2026c).

5.3 Comparison with other studies of copper in the EU

Several public studies describe copper flows, stocks and recycling in the EU; they differ in geography (EU-28 or EU-27), year, unit and method. The matrix below summarises scope, method, key results and data access, without ranking them. No public study combining an economic input-output module, a mass balance, a dynamic stock model, a screening environmental module and strategic indicators for the EU-27 was identified in the search for this report.

TABLE 29 Studies of copper in the EU: scope, methods, results and data access

Study	Scope	Method	Key results	Data access
Passarini et al. (2018), JRC	EU-28, 2014	Static MFA	Stock 140 kg/person; input to use ≈3.0 Mt; direct melting 1,042 kt; EoL-RR 61%; EoL-RIR 17%	Public report
Ciacci et al. (2017)	EU-28, 1960–2014	Dynamic MFA	Stock 160–200 kg/person; EoL-RR ≈60%; net import reliance 43%	Open access, supplement
Soulier et al. (2018)	EU-28, 1910–2014	Dynamic stock-flow model, Monte Carlo	Stock ≈82 Mt; ≈50% of copper refined and remelted from secondary sources; EoL-RIR 25–30%	Journal article
Ciacci et al. (2020)	EU-28, to 2050	MFA, regression, LCA scenarios	Old scrap covers at most ≈65% of demand	Journal article
ICA (2023a), Europe	EU-28, 2018	Industry synthesis	RIR 55% (27% end-of-life, 28% fabrication scrap); 10.3 Mt CO_2e	Public report
European Commission (2023), CRM study	EU, 2016–2020	Criticality assessment	Copper EoL-RIR 55%; import reliance 48%	Public report
European Commission (2025b), Steel and Metals Action Plan	EU-27	Policy document	EU production covers 83% of domestic copper demand	Public

Study	Scope	Method	Key results	Data access
ICSG (2026), World Copper Factbook	World, regions	Statistics	Europe 14% of world refined usage (2025)	Public summary; full data paid
CU-EU (this report)	EU-27, 2024	IO, mass balance, dMFA, LCA screening, Monte Carlo	See Chapters 5–8	Model package on request

Source: as stated. EoL-RR: end-of-life recycling rate; EoL-RIR and RIR: end-of-life and total recycling input rates (definitions differ between studies).

5.4 Comparison with economic contribution studies

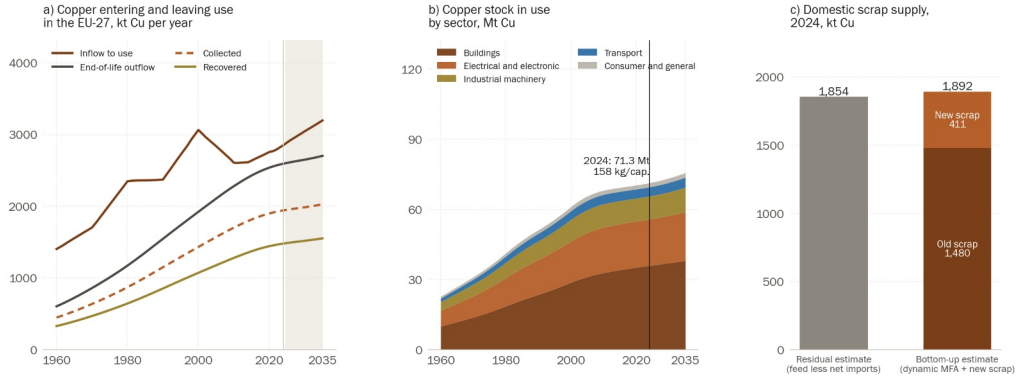
Economic contribution studies of metal industries use the same accounting but define the industry and the multiplier differently. For the EU-28 steel industry in 2017, Oxford Economics (2019) reports direct value added of EUR 25.4 billion and 327,700 jobs, and EUR 148.0 billion and 2.60 million jobs including supply-chain and induced effects – ratios of 5.8 for value added and 7.9 for jobs. The Copper Development Association reports more than 65,000 direct jobs in the US copper industry and more than 395,000 jobs including indirect and induced effects (CDA, undated; the study year is not stated), a ratio of about 6.1. The corresponding ratios of CU-EU are 1.94 (Type I) and 2.42 (Type II) for value added and 2.3 and 2.9 for jobs. The ratios are not fully comparable: CU-EU counts six segments from mines to cables as direct activity, removes purchases within the copper chain from first-round demand and counts only effects inside the EU, each of which lowers the ratio.

For the European copper industry the European Copper Institute reports about 500 companies of miners, producers and semi-fabricators with about EUR 45 billion of turnover and about 50,000 employees (ECI, undated; production data of about 2016 for the EU-28), and about 35,000 employees in about 80 semi-fabricating companies (ECI 2016, as cited in SCRREEN2 2023). The model gives 9,500 persons in smelting and refining (E2+E3) and 43,000 in semis and castings (E4, including foundries). The difference between the industry figure and the 112,000 persons of E0–E4 arises mainly in mining including the whole of KGHM (E0, 33,000) and in the collection and trade of scrap (E1, 27,000).

06 Copper in use and scrap supply

The dynamic model estimates that about 71.3 Mt of copper was in use in the EU-27 in 2024, or 158 kg per person (90% band 139–179). Buildings hold 50% of the stock and electrical and electronic equipment 28%. In 2024 about 2,850 kt of copper entered use and 2,590 kt reached end of life; 1,940 kt was collected and 1,480 kt recovered as old scrap. With the growth of electrification assumed in the central case the stock reaches 75.6 Mt in 2035 and recovered old scrap 1,550 kt.

FIGURE 11 Copper in use in the EU-27, 1960–2035, and domestic scrap supply in 2024



Source: IGMNiR CU-EU v1.1, module M2b; inflow-driven stock model 1960–2035; per-capita inflow anchored to the JRC MFA of 2014 (Passarini et al. 2018), shaped by EU-28 copper supply 1960–2010 (Ciacci et al. 2017) and the CU-EU balance for 2024; JRC end-use shares and lifetimes (normal, SD = 0.3 × mean); Glöser et al. (2013) collection and recovery by waste stream (transport collection: JRC end-of-life vehicle rate), scaled to European levels; population Eurostat (demo_gind, EUROPOP2023). Model estimates; 2025–2035 under the central inflow growth of 1.0% a year.

TABLE 30 Copper stock in use and end-of-life flows by end use, 2024 and 2035

End use	Stock 2024, Mt	End of life 2024, kt	Stock 2035, Mt	End of life 2035, kt
Buildings and construction	35.93	781	38.09	880
Electrical and electronic	19.89	796	20.78	796
Industrial machinery	9.81	557	10.53	544
Transport	3.91	247	4.25	247
Consumer and general	1.76	213	1.97	236
Total	71.31	2,594	75.63	2,703

Source: IGMNiR CU-EU v1.1, module M2b. Model results (status M).

TABLE 31 Sensitivity of the dynamic model

Case	Stock 2024, kg/person	End of life 2024, kt	Recovered 2024, kt	EoL-RR 2024, %	Recovered 2035, kt
Central	158	2,594	1,480	57	1,553
Lifetimes −20%	128	2,680	1,541	58	1,595
Lifetimes +20%	186	2,462	1,393	57	1,495
Historical inflow −15%	140	2,216	1,263	57	1,372
Historical inflow +15%	177	2,972	1,698	57	1,733
Inflow 1960 index 0.55	158	2,589	1,477	57	1,552
Inflow 1960 index 0.80	159	2,600	1,484	57	1,553
Collection at global rates	158	2,594	1,346	52	1,411
Collection +20%	158	2,594	1,615	62	1,694
No inflow growth after 2024	158	2,594	1,480	57	1,548

Case	Stock 2024, kg/person	End of life 2024, kt	Recovered 2024, kt	EoL-RR 2024, %	Recovered 2035, kt
Inflow growth 2% a year	158	2,594	1,480	57	1,557
Inflow 1998–2008 +25%	169	2,846	1,618	57	1,648
Flat per-capita inflow 1990–2024	150	2,433	1,390	57	1,471
Log-normal lifetimes	158	2,596	1,482	57	1,552
Half of end-of-life vehicles collected	158	2,594	1,414	54	1,486
Higher building share	164	2,567	1,493	58	1,578
New-scrap rate 25%, balance closed by recovery (collection scaling 0.79)	154	2,585	1,063	41	1,085

Source: IGMNiR CU-EU v1.1, module M2b.

Recycling indicators differ in definition. In CU-EU, 75% of copper in end-of-life products is collected and 76% of the collected copper is recovered, giving an end-of-life recycling rate of 57% – in the range of 60% reported for the EU by Ciacci et al. (2017) and of 61% (including exported scrap) by the JRC. Input-based rates are different: old scrap used in the EU is about 36% of copper input to refining and fabrication (EoL-RIR) at the new-scrap rate of 13% and about 26% at 25% (Section 3.6), and old and new scrap together 47% (RIR). The JRC reports an EoL-RIR of 17% for 2014, Soulier et al. (2018) 25–30%, while the 55% of the Commission's critical raw materials study corresponds to a total recycling input rate including new scrap (ICA 2023a: 27% end-of-life plus 28% fabrication scrap).

TABLE 32 Copper recycling indicators: CU-EU and published values for the EU

Indicator and definition	CU-EU 2024	Published	Source
End-of-life recycling rate (recovered / end-of-life outflow)	57%	≈60% (EU-28); 61% (EU-28 2014, incl. exports)	Ciacci et al. (2017); Passarini et al. (2018)
Collection rate (collected / end-of-life outflow)	75%	61% (old scrap collected / generated, 2014)	Passarini et al. (2018)
End-of-life recycling input rate (old scrap in input)	26–36%	17% (2014); 25–30%	Passarini et al. (2018); Soulier et al. (2018)
Recycling input rate incl. new scrap (RIR)	47%	55%	ICA (2023a); European Commission (2023)
Stock in use, kg per person	158	140; 160–200; ≈160	Passarini et al. (2018); Ciacci et al. (2017); Soulier et al. (2018)

Source: IGMNiR CU-EU v1.1 and as stated. Published values refer to the EU-28 and earlier years; CU-EU refers to the EU-27 in 2024. The EoL-RIR range corresponds to new-scrap rates of 25% and 13%; the end-of-life recycling rate and the stock depend on parameters taken from the published studies and their agreement is not an independent validation.

The residual estimate of domestic scrap supply (1,854 kt) – copper in secondary feed less net extra-EU imports of copper in scrap – differs from the bottom-up estimate (1,892 kt: 1,480 kt of old scrap recovered and 411 kt of new scrap) by −38 kt, with a 90% band of −287 to 328 kt. As explained in Section 3.6, the difference is not distinguishable from zero, its sign is not interpreted, and its small size is not an independent confirmation of the model, because the bottom-up estimate rests on the calibrated collection scaling and new-scrap rate; the parameters that move it most are listed there.

The dynamic model has three limitations. Its path of inflow is shaped by the copper supply of the EU-28 (including the United Kingdom) rather than by apparent consumption of final products; its 2024 level depends on an estimate of copper in net imports of finished products; and it was not validated against administrative data on waste electrical and electronic equipment, end-of-life vehicles or construction and demolition waste, nor against an inventory of the building stock.

07 Environmental contribution

According to data of the International Copper Association for 2023, as reported in the Aurubis Environmental Footprint Declaration (Aurubis 2026), a tonne of primary copper cathode produced worldwide carries a cradle-to-gate footprint of about 3.64 t CO_2e (3.965 t for 2019 data in ICA 2023b; 2.8 t in Nuss and Eckelman 2014). Producer averages for cathode made in the EU are lower: Aurubis 1.289 t in 2024 and KGHM about 1.69 t; both include copper from recycled feed, and the footprint of the primary part of EU production is estimated at about 2.0 t. Secondary copper produced in the EU – 864 kt melted directly and 850 kt of secondary refined copper – carries screening footprints of 0.30 t and 1.00 t CO_2e per tonne. Compared with one-for-one substitution of global average primary cathode it potentially avoided about 5,130 kt CO_2e in 2024 (90% band 3,750–5,900), mostly at mines and smelters outside the EU. The value of 3.64 t is taken from the Aurubis declaration, which cites ICA data for 2023; the most recent stand-alone ICA profile (ICA 2023b, representative of 2019, cradle-to-gate, covering 23% of world cathode output) gives 3.965 t, with which the result would be 5,690 kt (Section 7.1).

TABLE 33 Screening values for the EU copper routes, t CO_2e per t Cu (2024)

Route	t CO_2e/t	Range	Basis
Direct melting, whole site, per t Cu (incl. scrap preparation)	0.30	0.20–0.45	electricity 0.80 MWh/t Cu × 183.4 g/kWh = 0.147 t
Secondary smelting and refining in the EU	1.00	0.60–1.80	Boliden 0.40 (Harjavalta) and 1.35 (Rönnskär), Brixlegg ≈0.63, Nuss and Eckelman 1.8
Secondary copper, weighted by output	0.65		weights 864 kt and 850 kt
Primary cathode, global average	3.64	2.80–3.965	ICA (2023b); Aurubis (2026)

Source: IGMNiR CU-EU v1.1; EEA (2026) grid intensity 2024; company declarations; Nuss and Eckelman (2014). The direct-melting value is a whole-site value per tonne of copper and therefore an upper estimate of the increment over melting cathode; zinc in brass is not credited.

TABLE 34 Published carbon footprints of copper products made in the EU, t CO_2e per t

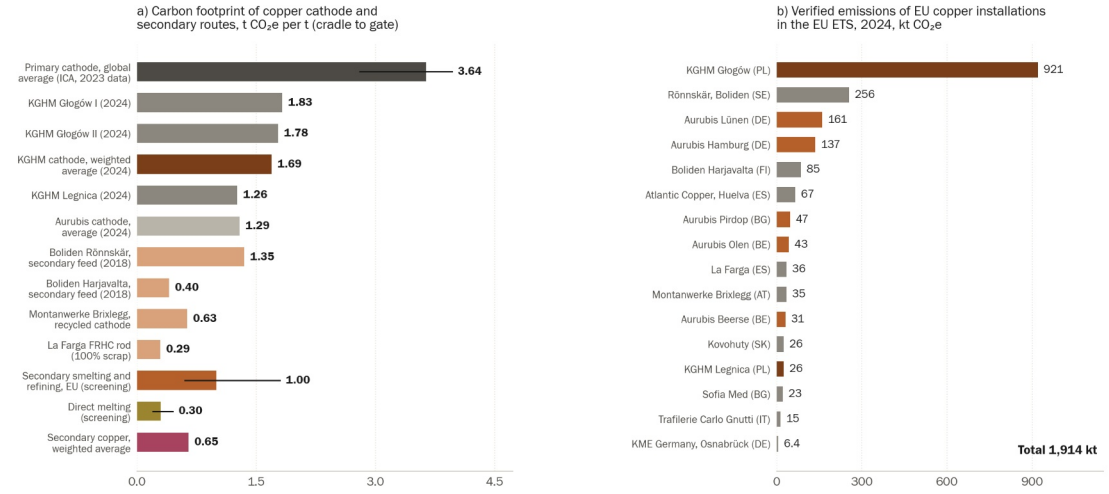
Product	t CO_2e/t	Note	Source
Aurubis cathode, average of 5 EU sites	1.289 (2024); 1.254 (2025)	Recycled content 44% (2025)	Aurubis (2026)
KGHM cathode, Legnica / Głogów I / Głogów II	1.261 / 1.830 / 1.777 (weighted ≈1.69)	Scope 1–3, ISO 14067, 2024	Kulczycka et al. (2026)
Boliden cathode by feed, Rönnskär (Aitik / secondary)	1.45 / 1.35	2018 data	Boliden (2021)
Boliden cathode by feed, Harjavalta (Aitik / secondary)	1.70 / 0.40	2018 data	Boliden (2021)
Aurubis wire rod, average	2.067 (2024); 1.907 (2025)	Recycled content 37%	Aurubis (2026)
La Farga FRHC wire rod (100% scrap)	0.29	EPD S-P-02032	La Farga (2023)
ICA global: copper wire rod / tube / flat; brass rod	3.622 / 2.763 / 3.918; 1.061	2019–2021 data	ICA/IWCC/CDA (2024)

Source: as stated; cradle to gate. Footprints of different producers use different allocation, electricity accounting and cut-off rules and are not directly comparable.

Direct emissions of the copper installations themselves are reported in the EU Emissions Trading System. The 17 installations that can be identified by name as copper smelters, refineries or semis plants verified about 1.92 Mt CO_2e in 2024, of which KGHM Głogów 921 kt. These are Scope 1 emissions on site; the footprints above add electricity, purchased inputs and, for primary copper, mining and concentration. The list of installations is given in Section 2.3. Related to the cathode output of the site (466 kt), the verified emissions of KGHM Głogów would exceed the cradle-to-gate footprints of 1.78–1.83 t reported for Głogów cathode. Direct emissions per tonne cannot exceed a cradle-to-gate footprint that covers the same product and boundary, so the two figures cover different scopes: the ETS installation also produces lead, silver, gold, sulphuric acid and

other co-products and may include on-site energy units, while the footprint study allocates part of the emissions to co-products. The two figures have not been reconciled with the producer, and neither enters the central results of CU-EU. The value for KGHM Legnica covers only the installation registered under that name and cannot be related to the cathode output of the site.

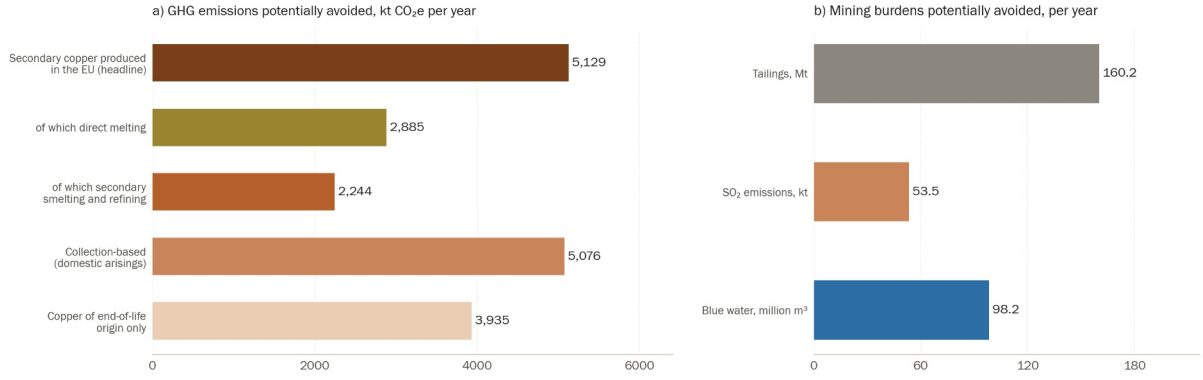
FIGURE 12 **Carbon footprint of primary and secondary copper routes**



Source: ICA data for 2023 as reported by Aurubis (2026); ICA (2023b); Aurubis Environmental Footprint Declaration 2026; Kulczycka et al. (2026); Boliden carbon footprint summary (2021, 2018 data); Montanwerke Brixlegg (company statement); La Farga EPD S-P-02032; Nuss and Eckelman (2014); EU ETS verified emissions (Union Registry, extraction 1 April 2026). Secondary refining and direct melting: IGMNiR screening values (Chapter 7); not ISO 14044 comparative LCAs. Lines show ranges in Annex B.

Counting only copper of end-of-life origin – secondary copper less the copper in new scrap used – the emissions potentially avoided are 3,930 kt CO_2e. Based on the copper collected as scrap in the EU they are 5,080 kt. The headline is a recycled-content perspective: it credits all secondary copper, including new scrap that returns from fabrication. Mining burdens potentially avoided amount to 160.2 Mt of tailings, 53.5 kt of SO_2 and 98.2 million m³ of water. Valued at the EU ETS average price of 2024 (EUR 64.74/t) the emissions potentially avoided are worth EUR 330 million; at the shadow cost of carbon of the European Investment Bank (European Investment Bank 2020; rebased to 2024 prices) EUR 1,060 million.

FIGURE 13 **Emissions and mining burdens potentially avoided by secondary copper produced in the EU-27, 2024**



Source: IGMNiR CU-EU v1.1, module M4; 1:1 substitution of global average primary copper cathode (ICA 2023) by secondary copper produced in the EU; avoided burdens arise largely outside the EU. Bars in a) are alternative attributions and are not additive, except the two sub-items of the headline.

7.1 Structural sensitivity

TABLE 35 Structural sensitivity of the emissions and tailings potentially avoided (2024)

Case	Headline, kt CO_2e	Direct melting	Secondary refining	Collection-based	Secondary footprint, t/t	Tailings, Mt
Central case	5,129	2,885	2,244	5,076	0.65	160.2
Substitution 0.8	3,881	2,256	1,625	3,841	0.65	128.2
Substitution 0.5	2,010	1,313	697	1,989	0.65	80.1
Copper of end-of-life origin only	3,935	2,213	1,722	5,076	0.65	122.9
Displaced cathode at the primary part of EU production (2.0 t)	2,318	1,468	850	2,294	0.65	160.2
Displaced cathode at the Aurubis average incl. recycled feed (1.289 t)	1,100	854	246	1,088	0.65	160.2
Displaced cathode: EU primary (2.0 t) and net imports (global average) weighted	2,789	1,706	1,083	2,760	0.65	160.2
Primary footprint 2.80 t	3,689	2,159	1,530	3,651	0.65	160.2
Primary footprint 3.965 t	5,686	3,166	2,520	5,627	0.65	160.2
Grid factor 2023 (205.7 g/kWh)	5,114	2,870	2,244	5,060	0.66	160.2
Secondary refining 0.60 t	5,469	2,885	2,584	5,412	0.45	160.2
Secondary refining 1.80 t (Nuss and Eckelman)	4,449	2,885	1,564	4,403	1.04	160.2
Direct melting 0.20 t	5,215	2,971	2,244	5,161	0.60	160.2
Direct melting 0.45 t	4,999	2,755	2,244	4,947	0.72	160.2
Bridge term d_ref −80 kt	4,862	2,618	2,244	4,814	0.66	152.8
Bridge term d_ref +80 kt	5,396	3,152	2,244	5,338	0.63	167.7
Secondary refined copper 750 kt	4,865	2,885	1,980	4,811	0.63	150.9
Secondary refined copper 950 kt	5,393	2,885	2,508	5,340	0.67	169.6

Source: IGMNiR CU-EU v1.1. With the displaced cathode at the Aurubis average, which includes recycled feed, the secondary refining route has a footprint close to that of the displaced cathode, and the result is driven by direct melting.

7.2 Boundaries and comparability

The screening values are not comparative life-cycle assessments under ISO 14044. They answer a narrow question: by how much does a tonne of copper from scrap add to the emissions of the EU copper industry, compared with the global primary tonne it may displace? The matrix summarises the methodological characteristics of the footprints used.

TABLE 36 Methodological characteristics of the footprints used

Element	ICA global primary	Aurubis cathode	KGHM cathode	CU-EU direct melting	CU-EU secondary refining
Functional unit	1 t cathode	1 t cathode (5 sites)	1 t cathode per site	1 t copper in semis	1 t secondary refined copper
System boundary	Cradle to gate	Cradle to gate	Cradle to gate	Whole site plus scrap preparation	Cradle to gate (screening)
Allocation	Mass (mining); economic for co-products	System expansion; economic for precious metals	ISO 14067; co-product allocation	Not needed (single output)	Not allocated
Electricity	Regional grids	Market-based	Supplier and own generation	Location-based, 183.4 g/kWh	Location-based
Recycled content	Primary only	44% recycled content	Own concentrate and purchased materials	Scrap, cut-off	Scrap, cut-off

Element	ICA global primary	Aurubis cathode	KGHM cathode	CU-EU direct melting	CU-EU secondary refining
Data quality	Industry LCA (ISO 14040/44)	Company declaration	Company LCA report	Company data plus estimate	Literature and company data

Source: ICA (2023b); Aurubis (2026); Kulczycka et al. (2026); IGMNiR CU-EU v1.1.

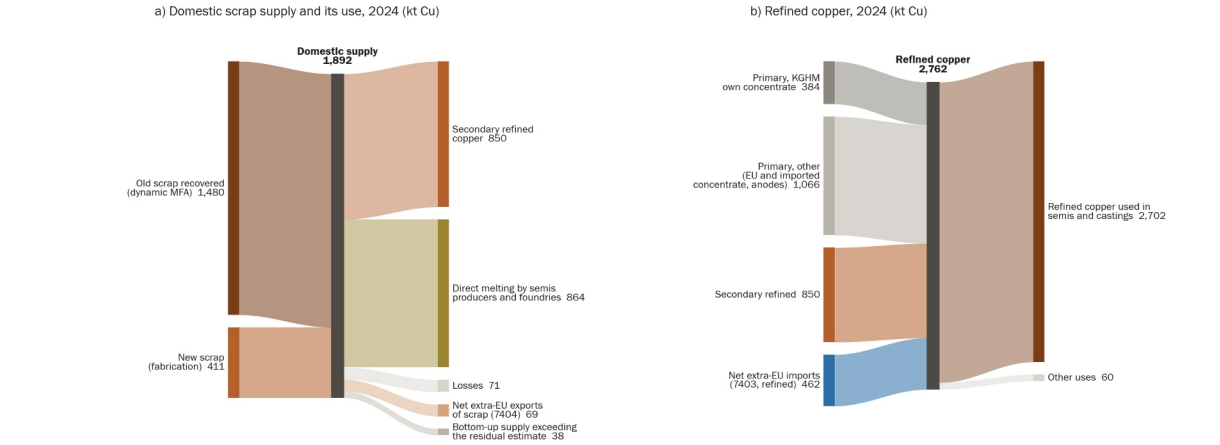
7.3 Uncertainty from the counterfactual

The emissions potentially avoided depend more on the counterfactual than on the screening values. Across the cases in Section 7.1 the headline result ranges from 1,100 to 5,686 kt CO_2e. First, the substitution ratio: if secondary copper partly adds to supply, the result falls proportionally (2,010 kt at 0.5). Second, the displaced copper: for the EU it is imported cathode or copper refined from imported concentrate, whose footprint is close to the global average; the footprint of the primary part of EU production is estimated at about 2.0 t, while the producer averages of Aurubis and KGHM (1.3–1.7 t) include recycled feed. With the displaced copper at 2.0 t the result is 2,318 kt, with EU primary output and net imports weighted 2,789 kt, and at the Aurubis average 1,100 kt. Third, the quantity of secondary copper (bridge term and secondary refined output). The Monte Carlo band does not cover these structural choices.

08 Strategic contribution

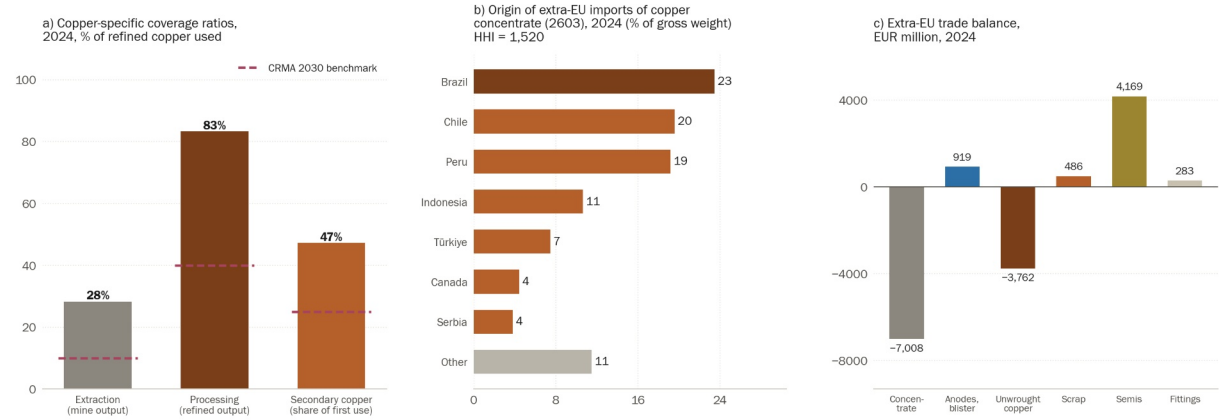
The EU-27 mined 782.3 kt of copper in 2024 and refined 2,300 kt, of which about 850 kt from scrap. It used 2,762 kt of refined copper and melted about 864 kt of copper in scrap directly. In extra-EU trade the EU imported 3,505 kt of concentrate (gross weight) and exported 1,094 kt, imported 735.3 kt of unwrought copper and exported 320.2 kt, and exported 608.4 kt of copper scrap while importing 408.1 kt. In semis (CN 7407–7411) exports exceeded imports by 430 kt.

FIGURE 14 Copper flows in the EU-27, 2024



Source: IGMNiR CU-EU v1.1 mass balance (M2) and dynamic MFA (M2b); company reports (KGHM 2025a); Eurostat Comext 2024 (CN 7404 at 80% Cu in imports and 65% in exports; CN 7403 excluding copper alloys). Direct melting is derived from the copper bridge; the difference between the bottom-up and the residual estimate of domestic scrap supply is a balance residual.

FIGURE 15 Supply security indicators for copper, 2024



Source: IGMNiR CU-EU v1.1; Eurostat Comext (DS-045409; extra-EU trade, imports by country of origin); Regulation (EU) 2024/1252, Art. 5(1). The CRMA benchmarks refer to EU capacity for strategic raw materials as a whole and are shown for orientation only; the secondary share relates secondary copper to copper first used, not to the CRMA definition of recycling capacity. HHI: Herfindahl–Hirschman index of partner countries (0–10,000).

The Critical Raw Materials Act sets benchmarks for strategic raw materials as shares of annual EU consumption: extraction at least 10%, processing at least 40%, recycling at least 25%, and no more than 65% from a single third country at any processing stage. Applied to copper as coverage ratios of 2024, EU mine output equals 28% of refined copper used (22% of copper first used), refined output 83% (63%) and secondary copper 47% of copper first used (62% of refined copper used); copper of end-of-life origin alone equals 36% of copper first used. The 65% limit refers to the share of a single third country in EU consumption; shares of extra-EU imports are larger than shares of consumption. The benchmarks are defined for the whole set of strategic raw materials

and on a capacity basis; the copper ratios are shown for orientation only. The processing ratio rests largely on imported concentrate and anodes: EU mines cover 28% of refined copper used, so the extraction stage depends on imports for about 72% of it. The end-of-life share depends on the new-scrap rate: at a rate of 25% instead of 13% it would be about 26% of copper first used.

TABLE 37 Copper coverage ratios and concentration compared with the CRMA benchmarks, 2024

Indicator	Copper 2024	CRMA benchmark 2030
Extraction: mine output / refined copper used; / copper first used	28%; 22%	≥10%
Processing: refined output / refined copper used; / copper first used	83%; 63%	≥40%
Recycling: secondary copper / refined copper used; / copper first used	62%; 47%	≥25%
Recycling, end-of-life origin only / copper first used	36%	≥25%
Largest supplier of concentrate imports (Brazil), share of extra-EU imports	23%	≤65%
Largest supplier of refined copper imports (Chile), share of extra-EU imports; share of EU use	38%; 10%	≤65%

Source: IGMNiR CU-EU v1.1; Regulation (EU) 2024/1252, Art. 5; Comext. Coverage ratios use output in 2024, the benchmarks refer to capacity in 2030 relative to annual EU consumption; the 65% limit refers to EU consumption, and shares of extra-EU imports are shown as upper values of exposure.

TABLE 38 Concentration of extra-EU copper trade by partner country, 2024

Flow	kt, gross weight	HHI	Largest partner	Top 1, %	Top 5, %
Concentrate imports (2603)	3,473.7	1,520	Brazil	23	80
Unwrought copper imports (7403)	735.0	2,287	Chile	38	86
Anode and blister imports (7402)	13.1	7,319	Chile	85	99
Scrap imports (7404)	408.1	1,196	United States	20	67
Scrap exports (7404)	608.6	2,240	China	43	76
Wire exports (7408)	331.1	1,322	Morocco	30	65

Source: Eurostat Comext (DS-045409), EU27_2020 reporter, extra-EU partners; IGMNiR CU-EU v1.1. HHI: Herfindahl–Hirschman index (0–10,000).

Stress tests show first-order exposures; they keep prices, other suppliers and stocks unchanged and are not forecasts.

TABLE 39 Stress indicators for the EU copper value chain, 2024 basis

Test	Size	Relative to
Electricity +EUR 50/MWh for smelting, refining (excluding KGHM) and semis	EUR 297 m a year	4.5% of GVA of E2–E4
Loss of the largest concentrate supplier (Brazil)	≈244 kt Cu	16.9% of primary refined output
Loss of the largest refined-copper supplier (Chile)	280 kt	10.1% of refined copper used
One-month outage of the Głogów refinery	38.8 kt	1.7% of annual EU refined output (Głogów 20%)
Doubling of net scrap exports (copper content)	69 kt Cu	3.9% of copper in secondary feed
Halving of gross scrap exports (copper content) retained in the EU	198 kt Cu	11.1% of copper in secondary feed; unused capacity for secondary feed ≈400 kt Cu
US tariff on semis: EU exports of CN 7407–7411 to the US, 2024	88.3 kt (EUR 1,108 m)	12.7% of extra-EU semis exports
Treatment and refining charges at the 2026 benchmark (zero) instead of 2024 (USD 80/t and 8.0 c/lb), primary refined output outside KGHM	up to EUR 410 m of charge revenue a year (≈EUR 404 per t Cu)	54% of GVA of E3 (upper bound)
Copper price +30% against the 2024 average (EUR 8,446/t), margins unchanged	EUR 17,000 m of metal value in output of E1–E5	17.9% of output of E1–E5; EUR 1,410 m of working capital per month of metal held

Source: IGMNiR CU-EU v1.1; Comext; KGHM (2025a); CRS (2026) for the US tariff (50% on semis from August 2025, on full value from April 2026). Electricity use of smelting and refining outside KGHM (3,350 GWh) and of semis (2,600 GWh) is an IGMNiR estimate; KGHM is part of E0. Copper in concentrate at 30% of the gross weight of all imports from the largest partner (the unit value of extra-EU concentrate imports in 2024, EUR 2,426/t, equals 29.8% of the value of payable copper at the 2024 LME price, before treatment charges and precious-metal credits). Unused capacity: secondary refined output up to 1,000 kt and direct melting up to 1,100 kt of copper (IGMNiR estimate), converted to feed with the recoveries of the model. The price test changes metal values only; value added in SBS reflects the margins of 2024, and the model has no margin response. The capacities are IGMNiR estimates of the EU total, about 18% and 27%

above output in 2024. The charge test applies the 2024 benchmark to all primary refined output outside KGHM at 30% Cu in concentrate; it is an upper bound, since part of the concentrate is mined by the smelting company itself or bought under other terms.

Smelters that process purchased concentrate earn treatment and refining charges (TC/RC). The annual benchmark agreed between Antofagasta and Chinese smelters fell from USD 80 per tonne and 8.0 cents per pound for 2024 to USD 21.25 and 2.125 cents for 2025 and to zero for 2026 (Reuters 2023; Reuters 2024; Reuters 2025). CU-EU values the output of smelters outside KGHM at the 2024 LME price plus 10% for by-products and margins (range 5–20%); at the charge levels of 2025–2026 the revenue of custom smelters depends to a larger extent on by-products such as sulphuric acid and precious metals. The model does not represent treatment charges, and its stress tests keep 2024 prices.

TABLE 40 **Strategic indicators for the EU copper value chain, 2024**

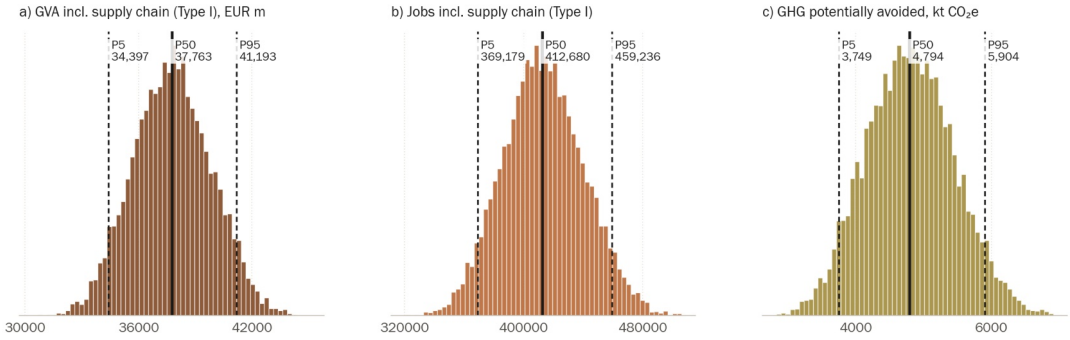
Indicator	Value	Source
Mine output, kt Cu	782.3	Reichl and Schatz (2026)
Refined output, kt	2,300	compiled (Chapter 3)
Refined copper used, kt	2,762	CU-EU
Secondary copper (refined and direct melting), kt	1,714	CU-EU
Coverage ratio: domestic scrap supply / scrap used (residual; bottom-up)	104%; 106%	CU-EU
Trade balance, concentrate (2603), EUR m	−7,008	Comext
Trade balance, unwrought copper (7403), EUR m	−3,762	Comext
Trade balance, scrap (7404), EUR m	486	Comext
Trade balance, semis (7407–7411) / fittings (7412), EUR m	4,169 / 283	Comext

Source: IGMNiR CU-EU v1.1; Eurostat Comext (extra-EU trade); Reichl and Schatz (2026).

09 Uncertainty, checks and limitations

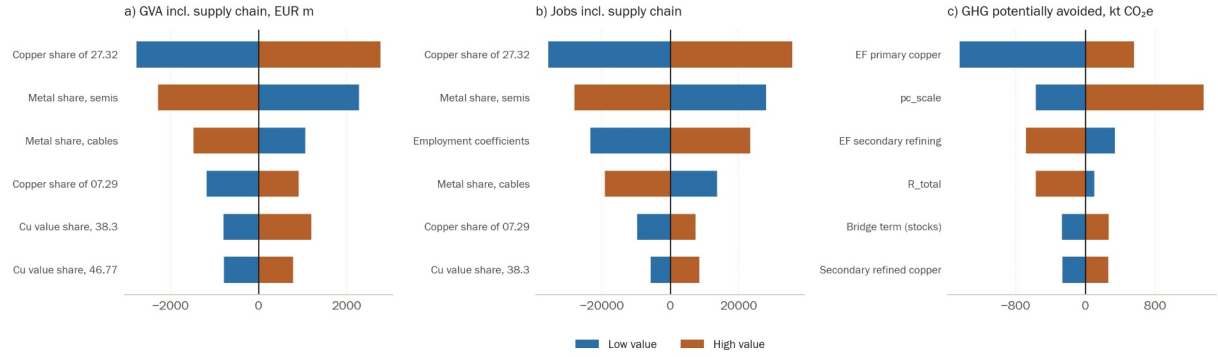
The 90% band of GVA including the supply chain is EUR 34,400–41,190 million, of jobs including the supply chain 369,000–459,000 and of the emissions potentially avoided 3,750–5,900 kt CO_2e. The economic results are driven mainly by three parameters (copper share of NACE 27.32; metal share of semis output; metal share of cable output), the emissions potentially avoided by two (footprint of primary copper; pc_scale). The median of the emissions potentially avoided (4,790 kt) is below the central value because the range of the primary footprint is skewed to lower values.

FIGURE 16 Monte Carlo distribution of key results



Source: IGMNiR CU-EU v1.1, module M6; 10,000 draws, triangular distributions with Gaussian copula (Annex B), seed 20261118. Parameter-uncertainty band within the model structure, not a statistical confidence interval.

FIGURE 17 Sensitivity of results to individual parameters



Source: IGMNiR CU-EU v1.1, module M6; one-at-a-time sensitivity on Annex B ranges; extended value chain.

TABLE 41 Robustness of the uncertainty band to the statistical design

Design	GVA Type I, EUR m (P5–P95)	Jobs Type I (P5–P95)	GHG potentially avoided, kt (P5–P95)
Reference (4,000 draws, seed 7)	34,400–41,270	369,000–460,000	3,730–5,920
No correlation	35,110–40,640	377,000–451,000	3,730–5,920
Correlation 0.95 in all groups	34,150–41,450	367,000–463,000	3,730–5,920
PERT distributions	34,760–41,120	374,000–458,000	4,030–5,950

Source: IGMNiR CU-EU v1.1, module M6. Separate test design (4,000 draws, seed 7) compared with the headline run (10,000 draws, seed 20261118). Convergence: with other seeds and 20,000 draws the percentiles of the key results change by at most 1.0%. Correlations are set in the normal space of the copula. The band of emissions potentially avoided is the same in the three correlation designs: the only parameter correlated with the primary footprint is the energy of primary copper, which does not enter the emission result.

TABLE 42 Structural tests of the economic and fiscal results

Case	GVA E1+E2	GVA E0–E5	GVA Type I	Jobs Type I	Taxes
Central case	2,959	19,578	38,061	417,000	13,403
Supply-chain effects −20%	2,959	19,578	34,364	370,000	12,174
Supply-chain effects +20%	2,959	19,578	41,758	464,000	14,632
EU-27 symmetric IO table 2023	2,959	19,578	38,259	417,000	13,107
Conservative first round	2,959	19,578	33,794	362,000	11,932
Smelting share, low	2,835	19,578	38,061	417,000	13,403
Smelting share, high	3,108	19,578	38,061	417,000	13,403
Copper share of mining, low	2,959	18,722	36,881	407,000	13,076
Copper share of mining, high	2,959	20,237	38,969	424,000	13,654
Metal share of semis, low	2,959	19,578	40,344	445,000	14,141
Metal share of semis, high	2,959	19,578	35,778	389,000	12,665
Copper-alloy share of castings, low	2,959	19,456	37,931	415,000	13,353
Copper-alloy share of castings, high	2,959	19,700	38,191	419,000	13,453
Copper share of cables, low	2,959	18,464	35,287	381,000	12,423
Copper share of cables, high	2,959	20,692	40,835	452,000	14,383
Scrap trade with employment key	2,254	18,873	36,817	410,000	13,137
Basic prices for all segments	3,008	19,890	38,373	417,000	13,403
Without the KGHM mineral extraction tax	2,959	19,578	38,061	417,000	12,592
By-products of smelters 5% of copper value	2,959	19,578	38,147	418,000	13,431
By-products of smelters 20% of copper value	2,959	19,578	37,888	415,000	13,347
Joint low (all allocation keys low, supply chain −20%)	2,138	16,665	25,619	265,000	9,293
Joint high (all allocation keys high, supply chain +20%)	3,960	22,474	53,708	610,000	18,586

Source: IGMNiR CU-EU v1.1; EUR million and persons.

TABLE 43 Parameter-uncertainty band and range of structural cases

Result	P5	P95	Structural minimum	Structural maximum
GVA Type I, EUR m	34,400	41,190	25,620	53,710
Jobs Type I	369,000	459,000	265,000	610,000
GHG potentially avoided, kt CO_2e	3,750	5,900	1,100	5,690

Source: IGMNiR CU-EU v1.1. The Monte Carlo band is conditional on the model structure: it does not cover errors of data classification or choices of system boundary, which the structural cases illustrate. The two ranges are not combined into one probability interval; the double-counting variant is excluded.

9.1 Consistency checks

TABLE 44 Consistency checks of the CU-EU model

Check	CU-EU value	Reference	Reference source	Independent of calibration
Refined output: sum of listed producers vs model central value (range), kt	2,284	2,300 (2,270–2,470)	company reports, USGS, BGS	no
Refined output 2024 vs 2023 (BGS), kt	2,300	2,466	BGS (2025)	yes
Copper in cables (model) vs wire rod and wire available (upper limit), kt	1,598	1,718	PRODCOM, Comext	no
Direct melting: CU-EU 2024 vs JRC 2014 (EU-28), kt	864	1,042	Passarini et al. (2018)	yes
Secondary share of refined output vs EU-28 1960–2014	37%	20–40% (median 30%)	Ciacci et al. (2017)	yes
Stock in use, kg per person, vs literature	158	140–200	JRC; Ciacci; Soulier	no
End-of-life recycling rate vs literature	57%	60–61%	Ciacci et al. (2017); JRC	no

Check	CU-EU value	Reference	Reference source	Independent of calibration
Employment reproduced by FIGARO coefficients, million (construction check)	219.4	219.4	nama_10_a64_e	construction
GVA Type I with the EU-27 SIOT vs FIGARO, %	0.5	0	naio_10_cp1700	yes
Monte Carlo convergence, max. change of percentiles, %	1.0	–	seeds 1, 2, 3; 20,000 draws	–
Replication from package files, max. absolute difference	0.021	0	replication script	–

Source: IGMNiR CU-EU v1.1. The model value of refined output is set above the sum of the listed producers to cover producers not listed; the JRC value refers to the EU-28 in 2014 and includes the United Kingdom. "No" marks comparisons with data or conditions that were used to set the model parameters: the refined-output total is compiled from the listed producers; the wire-rod condition bounds the copper share of cables and the scaling of semis volumes; the dynamic model takes its inflow profile, lifetimes and end-use shares from the JRC and from Ciacci et al. (2017) and its collection rates are scaled to their European level, so agreement of the stock and of the end-of-life recycling rate confirms the implementation, not the values.

9.2 Limitations

- **SBS gap filling.** EU-27 aggregates of the SBS are rounded and partly confidential; output of 24.44, value added of 27.32, personnel costs of 38.3 and of 07.29 and employment of 07.29 were completed from member-state sums or earlier ratios (status E); cells published in rounded form are used as published.
- **Classification of KGHM.** KGHM's smelters and refineries are part of the mining enterprise (E0). If part of its activity were classified to 24.44, value added and employment would move between E0 and E2–E3, and the totals would also change, because the two parts are derived from different statistics and keys.
- **Classification of other integrated producers.** Boliden Mineral AB, which operates the Swedish mines and the Rönnskär smelter in one legal entity, is registered with main activity 07.29 and secondary activity 24.44 (Näringslivsregistret 2026). If structural statistics record Rönnskär under 07.29, its employment is counted in E0 and should not enter the employment key of 24.44; the key then overstates the smelting share of 24.44 by the Rönnskär headcount.
- **Smelting share of 24.44.** The share of smelting and refining in 24.44 follows employment of named smelters; value added per person may differ from the rest of 24.44.
- **Refined output.** EU refined output is compiled from company reports, USGS and BGS, partly on fiscal years; PRODCOM understates it because of confidential data.
- **Scrap balance.** The residual and bottom-up estimates of domestic scrap supply differ by −38 kt in the central case, with a 90% band of −287 to 328 kt; the split of secondary copper into old and new scrap depends on the new-scrap rate (end-of-life share of copper first used 26–36% for rates of 25% and 13%); copper leaving the EU in forms other than CN 7404 and stocks of scrap are not observed.
- **Allocation keys.** The copper shares of NACE 07.29, 46.77, 38.3 and 27.32 are assumptions (class C) that are not checked bottom-up against company accounts; E0, E1 and E5, which depend on them, account for about two thirds of direct value added. In 07.29 the key describes the copper-producing enterprises, including their by-products (silver, gold, lead, zinc), not copper metal alone.
- **Treatment charges and prices.** Value added of primary smelting and refining reflects the treatment charges and the copper price of 2024; the stress test shows the order of magnitude of charge revenue at the 2024 benchmark, which fell to zero for 2026.
- **Fiscal module.** The implicit tax rate on labour is the EU-27 average, not weighted by the distribution of employment across Member States; the value of free allocation of emission allowances to copper installations is not quantified.
- **Direct melting.** Copper from direct melting is derived from the bridge and compared only with the JRC estimate for the EU-28 in 2014; data of ICSG and IWCC on direct scrap use by fabricators were not used.
- **Intra-EU trade.** Treating the EU as one economy nets out trade between member states; the model does not show which member states gain or lose from flows inside the EU.

- **Dynamic model.** The inflow path relies on EU-28 supply data and the 2024 level on an estimate of copper in net imports of products; no validation against waste statistics was made.
- **Environmental values.** Screening values for direct melting and secondary refining are not ISO 14044 assessments; the displaced primary copper is set at the global average.
- **Input-output module.** FIGARO and the EU-27 symmetric table aggregate copper with other metals and cables with other electrical equipment; multipliers apply to the average structure of these products.
- **Valuation of smelters.** The output of E2–E3 is valued physically at the LME price plus a margin for by-products (5–20%); their value added and employment follow the employment key of 24.44.
- **Taxes and support.** Taxes are model attributions with average rates, plus the Polish mineral extraction tax paid by KGHM; compensation of indirect emission costs for copper is known only for Germany and for KGHM and is not netted.

10 Scenarios to 2035

The scenarios are illustrative combinations of assumptions, not forecasts. They keep 2024 prices and input-output coefficients and change volumes, footprints and labour productivity (+1.0% a year, applied to all jobs). Old scrap recovered follows the dynamic model, and refined copper used and the activity of semis follow the copper bridge; wire rod, which supplies the cable industry, grows with copper in cables. S1 (2030) assumes moderate growth of recycling and cables; S2 (2035) assumes high circularity in line with the orientation of the Critical Raw Materials Act – more secondary refining and direct melting, higher mine output and cleaner routes; S3 (2030) is a stress case with lower activity across the chain (primary refining outside KGHM −15%; KGHM's refining follows mine output).

TABLE 45 Scenario assumptions (change versus 2024)

Driver	S1 2030	S2 2035	S3 2030
Secondary refined copper	+10.0%	+22.0%	−10.0%
Direct melting of scrap	+5.0%	+12.0%	−15.0%
Scrap collection and trade (E1)	+5.0%	+12.0%	−10.0%
Mining incl. KGHM smelting (E0)	0%	+10.0%	−5.0%
Primary refining outside KGHM (E3)	0%	0%	−15.0%
Semis other than wire rod, and castings (E4)	0%	+5.0%	−10.0%
Wire rod (follows copper in cables)	+10.0%	+20.0%	0%
Semis and castings (E4), weighted	+5.5%	+13.3%	−4.5%
Copper in cables (E5)	+10.0%	+20.0%	0%
Footprint of primary copper	−5.0%	−12.0%	−5.0%
Footprint of secondary copper	−15.0%	−30.0%	−5.0%

Source: IGMNiR CU-EU v1.1. Secondary refining is limited to 1,000 kt and direct melting to 1,100 kt of copper. Additional secondary feed has a lower yield and a higher footprint. Wire rod accounts for 55% of copper in semis and castings; the E4 index is the weighted average of wire rod and the other products.

TABLE 46 Copper balance in the scenarios (kt Cu)

Item	2024	S1 2030	S2 2035	S3 2030
Secondary refined copper	850	935	1,000	765
Direct melting	864	907	967	734
Refined copper used	2,762	2,916	3,130	2,735
Old scrap recovered (dynamic model)	1,480	1,519	1,553	1,519
Additional copper in secondary feed vs 2024	0	139	276	−223
Additional domestic scrap vs 2024	0	64	133	18
Additional feed not covered by additional domestic scrap	0	76	142	−241
Refined copper produced	2,300	2,385	2,493	2,041
Net imports of refined copper (use less production)	462	531	637	694
For comparison: net extra-EU exports of copper in scrap, 2024	69	69	69	69
For comparison: gross extra-EU exports of copper in scrap, 2024	395	395	395	395

Source: IGMNiR CU-EU v1.1.

In S1 direct value added rises to EUR 20,610 million and in S2 to EUR 22,280 million; in S3 it falls to EUR 18,680 million. Employment including the supply chain, adjusted for productivity, is about 418,000 in S1, 431,000 in S2 and 378,000 in S3 (without the productivity adjustment 480,000 in S2). The emissions

potentially avoided are 5,310 kt in S1 and 5,300 kt in S2. In S2 the additional secondary feed exceeds the growth of domestic scrap projected by the dynamic model by about 142 kt of copper (S1: 76 kt). This is 2.1 times the net extra-EU exports of copper in scrap in 2024 (69 kt Cu) and 36% of gross exports (395 kt Cu). Refined copper used rises from 2,762 kt to 2,916 kt in S1 and 3,130 kt in S2. Refined output does not keep pace: in S2 it reaches 2,493 kt, so net imports of refined copper rise from 462 kt to 637 kt and the coverage of use by EU refined output falls from 83% to 80%. The increase of net cathode imports (175 kt) is larger than the scrap feed gap; the scenarios assume that rising use is covered by imports of cathode.

Published outlooks place these assumptions in context. The IEA (2025) finds that mined supply from announced projects would fall about 30% short of copper demand in 2035 in its Stated Policies Scenario. S&P Global (2026) projects world demand rising from 28 Mt in 2025 to 42 Mt in 2040 and a deficit of about 10 Mt, although recycled copper rises from about 4 Mt to 10 Mt. For Europe, KU Leuven (Gregoir and Van Acker 2022) estimates that copper needs rise from 4.3 Mt in 2020 to 5.9 Mt in 2050 (+35%), and ICA (2023a) assumes European refined demand growing by about 1% a year to 2050; Ciacci et al. (2020) find that old scrap covers at most about 65% of EU demand. In CU-EU refined copper used rises by 6% to 2030 in S1 and by 13% to 2035 in S2. The scenarios assume that concentrate remains available on 2024 terms; they do not represent a global shortage of concentrate or its effect on the price and availability of feed for EU smelters.

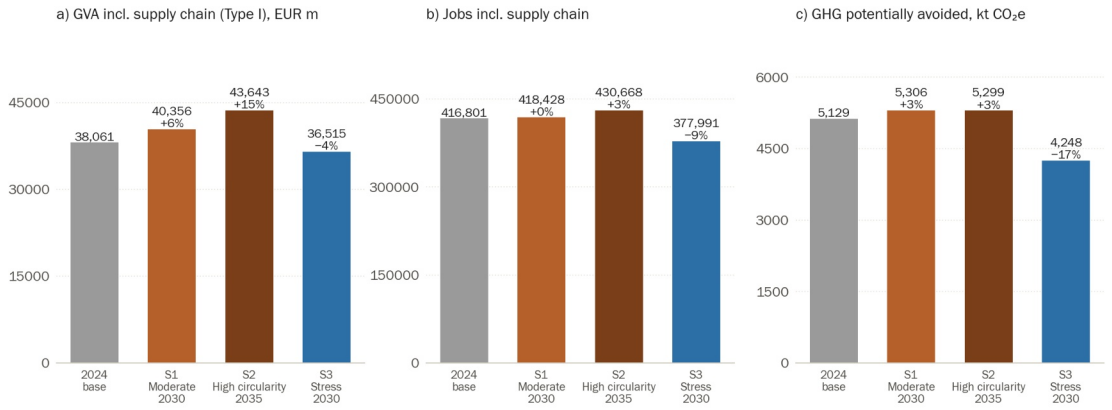
TABLE 47 Decomposition of the change in emissions potentially avoided from 2024 to scenario S2, kt CO_2e

Step	Emissions potentially avoided	Change
2024 base	5,129	
More secondary copper (volume)	5,871	+742
Lower-grade marginal feed	5,821	−50
Lower secondary footprint	6,158	+337
Lower primary footprint	5,299	−859
S2 2035	5,299	+170

Source: IGMNiR CU-EU v1.1; sequential decomposition, the order of steps affects the attribution.

The scenarios have no feedback between scrap prices, scrap quality, scrap exports and capacity use, and they do not show that the volumes are economically feasible. Not modelled are: the supply of scrap by grade, premiums for high-grade scrap, the cost of sorting and pre-treatment, energy prices, the availability and price of cathode and concentrate, and the response of trading partners.

FIGURE 18 Scenario results: change versus 2024



Source: IGMNiR CU-EU v1.1; 2024 prices; assumptions in the scenario table; labour productivity +1% a year; footprints of both routes decline over time.

11 Summary

In 2024 the EU-27 mined 782 kt of copper, refined about 2,300 kt and used about 2,760 kt of refined copper. The extended copper value chain – from mining through scrap trading, smelting and refining and semis to cables – generated about EUR 19.6 billion of direct value added and employed about 183,000 people; with its EU supply chain it supported EUR 38.1 billion of value added and about 417,000 jobs, and about EUR 13.4 billion of taxes and contributions excluding VAT.

Secondary copper – about 860 kt melted directly by semis producers and 850 kt refined – supplied 47% of copper first used in the EU. The copper stock in use is about 71 Mt (158 kg per person); end-of-life products released about 2,590 kt of copper in 2024, of which about 1,480 kt was recovered. The EU exported 200 kt more copper scrap (gross weight) to countries outside the EU than it imported.

Depending on the counterfactual, secondary copper produced in the EU potentially avoided between about 1.1 and 5.7 Mt CO_2e in 2024; replacing global average primary copper one-for-one, about 5.1 Mt, and about 3.9 Mt counting only copper of end-of-life origin; most of the burdens potentially avoided would have arisen in mining countries outside the EU. EU mine output equals 28% and EU refined output 83% of refined copper used in the EU. In scenarios S1 (2030) and S2 (2035) the additional secondary feed exceeds the growth of domestic scrap projected by the dynamic model, in S2 by about 142 kt of copper – more than the net extra-EU exports of copper in scrap in 2024 and less than gross exports.

A Data sources

TABLE 48 Main data sources of the CU-EU model

Domain	Source	Use in CU-EU
Structural business statistics	Eurostat sbs_ovw_act, EU-27 and member states, 2021–2024	Output, value added, employment, labour costs, turnover (07.29, 46.77, 38.3, 24.44, 24.54, 27.32); missing EU cells completed from member-state sums and earlier ratios
Production and trade	Eurostat PRODCOM (DS-059358), 2019–2024; Comext DS-045409, reporter EU27_2020, 2015–2025	Refined copper, anodes, semis and castings; extra-EU trade in CN 2603 and 7401–7413, partners, unit values
Input-output and national accounts	Eurostat FIGARO naio_10_fcp_ip4, 2024, aggregated to the EU-27 block; EU-27 symmetric table of Eurostat (naio_10_cp1700, 2023) as validation; nama_10_a64(_e)	Intra-EU coefficients, value added, household demand; employment
Mining and refining	Reichl and Schatz (2026), World Mining Data; USGS (2026); BGS (2025); KGHM, Aurubis, Boliden, Freeport-McMoRan (Atlantic Copper) and other company reports	Mine output by member state, refined copper by producer, scrap and concentrate inputs
Policy, taxes and public support	EUR-Lex; European Commission (CRMA lists, action plans, Carbon Market Report); DEHSt (2026); IGMNiR (2026c); DG TAXUD, Data on Taxation Trends 2026	Legal framework; indirect-cost compensation; tax rate on labour
Energy and emissions	EEA (grid GHG intensity 2024); Union Registry verified emissions; Eurostat nrg_pc_205	Grid factor; verified emissions of copper installations; industrial electricity prices
Dynamic model of copper in use	Passarini et al. (2018, JRC); Ciacci et al. (2017); Glöser et al. (2013); Eurostat demo_gind and proj_23np	End-use shares, lifetimes, collection and recovery rates; historical per-capita supply; population
Life-cycle data	ICA (2023b); ICA/IWCC/CDA (2024); Nuss and Eckelman (2014); Aurubis (2026); Kulczycka et al. (2026); Boliden (2021); product EPDs	Footprints, energy, tailings, acidification, water

Eurostat (2026a, 2026b); data as available on 31 October 2026.

TABLE 49 First-round demand within the EU by segment and product group, 2024 (EUR m)

Product group (CPA)	E0	E1	E2	E3	E4	E5
Electricity, gas, steam	259	116	70	103	1,207	307
Coke and refined petroleum	101	49	15	22	255	39
Chemicals	77	50	17	26	301	325
Rubber and plastics	23	32	7	10	118	516
Transport and storage	334	428	53	78	912	725
Repair and installation	170	51	22	33	380	207
Fabricated metal, machinery	98	94	52	77	899	1,262
Professional and support services	521	766	54	80	930	1,698
Motor-vehicle trade and retail trade	119	102	18	26	303	484
Other products	580	880	79	117	1,366	4,596
Total first-round demand within the EU	2,281	2,568	387	570	6,671	10,160
Non-chain intermediate consumption, all origins	2,544	2,761	442	652	7,632	12,326
First round within the EU relative to the row above	90%	93%	87%	87%	87%	82%

Source: IGMNiR CU-EU v1.1; FIGARO 2024 aggregated to the EU-27 block (intra-EU and all-origin coefficients). For E1 the first round equals the intra-EU input coefficients of the parent products (CPA_G46, CPA_E37-39), with purchases within the chain removed, times output; for E0 and E2–E5 purchases of metals, ores, scrap, wholesale trade and waste services (CPA_C24, CPA_B, CPA_G46, CPA_E37-39) are excluded as purchases within the chain and the remaining inputs are spread with the all-origin structure of the parent product (CPA_B for E0, CPA_C24 for E2–E4, CPA_C27 for E5). The full vectors by 64 CPA products are in the model package (file 04).

TABLE 50 Specification of the input-output module

Element	Specification
Table	Eurostat FIGARO, product-by-product, 2024 (naio_10_fcp_ip4, edition of July 2026), downloaded for each of the 27 member states as destination and aggregated: deliveries from any member state count as domestic (origin EU), deliveries from outside the EU as imports; 64 CPA products. Validation with the EU-27 symmetric input-output table of Eurostat for 2023 (naio_10_cp1700, EU27_2020), converted to the 64 FIGARO products
Multipliers	Type I: $L = (I - A_EU)^{-1}$; Type II: households endogenised – labour income × (1 – tax rate on labour) × propensity to consume, spent with the household consumption structure of products made in the EU
Employment	Persons employed 2024 (nama_10_a64_e, EU27_2020) per unit of output of the table, by CPA product; where 2024 is published only for the NACE section, the 2023 detail is scaled by the 2023–2024 change of its section. Applied to the FIGARO output the coefficients give 219,376 thousand persons against 219,376 thousand in the national accounts (a construction check). For the 2023 symmetric table, output is scaled to 2024 by the nominal growth of output by industry
E0 first round	Non-metal intermediate inputs = output − GVA − share of metal-bearing inputs × output; spread with the all-origin structure of CPA_B excluding chain products; the part produced in the EU enters the Leontief model
E1 first round	Intra-EU input coefficients of CPA_G46 (46.77) and CPA_E37-39 (38.3) excluding chain products, times the output of the copper share; structural test: all SBS intermediate consumption spread over the parent column
E2–E5 first round	Non-metal intermediate inputs = output − GVA − metal share × output; spread with the all-origin structure of CPA_C24 (E2–E4) or CPA_C27 (E5) excluding metals, ores and scrap; the part produced in the EU enters the Leontief model
Value added	All segments from structural business statistics (value added at factor cost); indirect and induced value added at basic prices (FIGARO); conversion of direct value added to basic prices with FIGARO net other taxes on production as a structural test
Taxes	Implicit tax rate on labour of the EU-27 × labour cost; corporate income tax at the EU-27 average statutory rate (21.8%, IGMNiR estimate, class C) × taxable share of operating surplus; net taxes on production and on products used from FIGARO coefficients, net of other subsidies; Polish mineral extraction tax paid by KGHM (KGHM 2025a; IGMNiR 2026c) less the production taxes of mining already implied for KGHM by the coefficient of CPA_B

Model package. The CU-EU package archived by IGMNiR contains the model modules M1–M6 and M2b (Python), all input data with extraction dates and dataset codes, the parameter file with sources and ranges (Annex B), scenario definitions, automated consistency checks and the run log. Machine-readable files accompany each run: results by segment, first-round demand vectors, the copper balance and dynamic-model series, route footprints, parameters with reliability classes and the correlation matrix, Monte Carlo summaries and a SHA-256 manifest. A replication script recomputes direct and Type I value added and employment from these files (largest difference 0.021); a quality-control script checks the key numbers in both language versions. Run ID: CUEU-1.1-ee42378f93.

TABLE 51 Input data files of the model package

File	Content	Size, KB	SHA-256 (first 16 characters)
comext_eu_extra.csv	Comext, extra-EU trade in copper	52	a5a04f8f8a5638cd
comext_eu_intra.csv	Comext, intra-EU trade in copper	19	002e3fc2a408b050
comext_eu_other_sec.csv	Comext, other secondary materials (extra-EU)	5	97f68cbdaa9c13df
comext_eu_partners.csv	Comext, copper trade by partner	418	56bae1b65e517196
eu_facilities.csv	Installations (Annex C)	4	7acab07612acf7ef
figaro_eu_2024.csv	FIGARO 2024 (naio_10_fcp_ip4) aggregated to the EU-27 block	453	1592e127348e2772
nama_emp.csv	Employment by industry, EU-27 (nama_10_a64_e)	14	9de1201f70535eca
nama_gva.csv	Output and value added by industry, EU-27 (nama_10_a64)	32	87635fdbae4cec3e
pop_eu.csv	Population on 1 January (demo_pjan)	2	b1c030433a387315
pop_eu_gind.csv	Population on 1 January, 1960–2026 (demo_gind)	1	d482e1492f5f2cdf
popproj_eu.csv	Population projections EUROPOP2023 (proj_23np)	0	cae7ca1b1e6f1238

File	Content	Size, KB	SHA-256 (first 16 characters)
prodcom_eu.csv	PRODCOM, copper products, EU-27 (DS-059358)	18	4e3e4cbbfbb5fcaa
sbs_eu.csv	Structural business statistics, EU-27 and member states (sbs_ovw_act)	400	8401704a8a6a4ce3
siot_eu.csv	Symmetric input-output table of the EU-27, Eurostat (naio_10_cp1700), 2021–2023	2,566	784ea53d739d887b
siot_eu_2023.csv	Same table, 2023, converted to the FIGARO layout (validation)	385	adb811bad14e15c6

Source: IGMNiR CU-EU v1.1, package file 09 (full hashes of code, data and results). Eurostat data as available on 31 October 2026.

Replication. The package runs with Python 3 (numpy, pandas, scipy, matplotlib, pypdf), Node.js with the docx library and LibreOffice. The command bash build_all.sh recomputes the model, the Monte Carlo runs, the figures and the EN and PL reports; bash build_all.sh --no-mc reuses the stored Monte Carlo results. The download script eu_download.py retrieves all Eurostat inputs (the FIGARO extract is downloaded for each member state and aggregated). The run identifier in results/run_id.txt (CUEU-1.1-ee42378f93) is a hash of the parameters, the code and the input data and must be identical after replication; file 09_manifest_sha256.csv lists the SHA-256 hashes of all files, and the replication script recomputes the headline results from the stored parameters (largest difference 0.021). Eurostat data are reused under the Eurostat copyright notice. Data with restricted use are not redistributed: company reports (quoted values only), paywalled statistical yearbooks (not used) and commercial market studies (not used). The package is archived by IGMNiR and available on request.

B Parameters and uncertainty ranges

Each uncertain parameter is described by a triangular distribution (low, central, high) within one dataset family; alternative datasets, boundaries, split keys and footprints are treated as structural cases (Chapters 5, 7 and 9). Reliability classes: A – official statistics, scientific literature or company financial statements; B – industry or company data; C – IGMNiR assumption or derived value.

TABLE 52 CU-EU parameters

Parameter	Central	Low	High	Class	Basis and source
Copper share of 07.29	0.750	0.620	0.850	C	copper share of NACE 07.29 (mining of other non-ferrous metal ores) in the EU: KGHM (copper, silver), Boliden, Atalaya, MATSA, Neves-Corvo, Assarel, Ellatzite, Chelopech; rest zinc, lead, nickel ores
Metal-bearing inputs, mining enterprises	0.150	0.080	0.250	C	share of purchased metal-bearing inputs (concentrate, scrap) in the output of copper mining enterprises: KGHM purchased materials 35% of its electrolytic copper
Copper value share, 46.77	0.200	0.140	0.260	A/C	copper share of the value of NACE 46.77 (wholesale of waste and scrap) in the EU-27: NF share ≈0.40 x copper share of NF scrap value ≈0.5 (extra-EU trade in CN 7404 EUR 5.8 bn in 2024)
Copper employment share, 46.77	0.120	0.080	0.160	C	copper share of employment in NACE 46.77
Copper value share, 38.3	0.050	0.030	0.080	C	copper share of the value of NACE 38.3 (materials recovery of all waste streams): cable granulation, WEEE and ELV dismantling
Copper employment share, 38.3	0.045	0.025	0.070	C	copper share of 38.3 employment
Smelting and refining share of 24.44	0.210	0.160	0.270	A/C	share of smelting and refining in NACE 24.44 (EU-27): employment of copper smelters and refineries classified to 24.44 (Aurubis Hamburg, Lünen, Pirdop, Olen, Beerse, Berango; Boliden Rönnskär, Harjavalta; Atlantic Copper; Montanwerke Brixlegg; others) ≈8,000–10,000 of 45,175 persons employed
Metal share, smelting and refining	0.850	0.800	0.900	A/C	metal share of the output value of smelting and refining (concentrate at payable copper, scrap and anodes): Aurubis revenue 18,171 €m vs operating EBITDA ≈589 €m
By-products and margins of smelters, share of copper value	0.100	0.050	0.200	C	value of by-products (precious metals, sulphuric acid, minor metals) and refining margins relative to the LME value of refined copper output of smelters and refiners classified to NACE 24.44

Parameter	Central	Low	High	Class	Basis and source
Metal share, semis and castings	0.680	0.600	0.760	A/C	metal share of output value of semis and castings: KME SE 2024 revenue 1,540.8 €m vs revenue net of raw materials 499 €m (0.68)
Copper-alloy share of 24.54	0.400	0.300	0.500	C	copper-alloy share of the value of NACE 24.54 (casting of other non-ferrous metals; rest mainly zinc die-castings)
Copper share of 27.32	0.750	0.600	0.900	C	copper-conductor share of activity of NACE 27.32 (rest aluminium conductors and optical fibre)
Copper share of cable output value	0.430	0.380	0.500	A/C	copper share of output value of wires and cables, constrained by the copper available to the cable industry: wire rod production 1,963 kt plus net extra-EU imports of wire and stranded wire less other uses of rod (≈100 kt) ≈1.6 Mt; implied copper m5 x cu_cable x output / LME ≈1.6 Mt
Secondary refined copper, kt	850	750	950	B/C	secondary refined copper in the EU-27, kt Cu: bottom-up in copper content – KGHM 158.6 kt from scrap; Aurubis ≈450-480 (recycled content 44% of 1,092 kt cathode, EFD 2026; scrap and blister 510 kt and other recycling materials 510 kt gross); Montanwerke Brixlegg ≈100; Spain other than Atlantic Copper and Italy ≈90; Harjavalta and Atlantic Copper e-scrap ≈30-45; Ciacci et al. 2017: secondary share of EU-28 refining 20-40%
Bridge term: refined use not entering semis, kt	0.000	−80.000	80.000	C	difference between apparent use of refined copper and refined copper entering semis and castings (stock changes, other uses not covered), kt Cu
Refined copper produced in the EU-27, kt	2,300	2,270	2,470	A/B/C	refined copper produced in the EU-27, kt (range includes the BGS 2023 total of 2,466 kt): KGHM 588.7, Aurubis Hamburg/Lünen 505, Olen/Beerse 358, Pirdop 229 (fiscal year 2023/24), Atlantic Copper 254.4, Harjavalta 159, Brixlegg ≈100, Spain and Italy other ≈90; high end: USGS/BGS country totals
Scaling of PRODCOM semis volumes	1.00	0.95	1.12	C	scaling of the PRODCOM quantities of semis entering the bridge: several EU cells are rounded Eurostat estimates and captive or toll production may be incompletely recorded (bars 1,391 kt in 2022, 916 kt in 2023); upper end consistent with the copper needed by the cable industry
Copper content of bars, rods and profiles	0.660	0.600	0.700	C	average copper content of bars, rods and profiles in the EU: free-cutting brass 57-59% Cu, copper bars and busbars 100% (extra-EU exports of CN 7407 at EUR 8,920/t indicate a substantial copper share)

Parameter	Central	Low	High	Class	Basis and source
Copper content of plates, sheets and strip	0.850	0.800	0.920	C	average copper content of plates, sheets and strip (copper and brass strip)
Copper-alloy castings, kt gross	200	150	250	C	copper-alloy castings in the EU-27, kt gross (brass, bronze; CAEF members)
Copper recovery, secondary smelting and refining	0.950	0.920	0.970	C	copper recovered per t of copper in secondary feed of smelting and refining
Copper content of scrap imports (CN 7404)	0.800	0.720	0.880	A/C	copper content of extra-EU imports of scrap CN 7404: unit value EUR 6,540/t = 0.77 of LME at a payable ratio of ≈0.95
Copper content of scrap exports (CN 7404)	0.650	0.580	0.750	A/C	copper content of extra-EU exports of scrap CN 7404: unit value EUR 5,186/t = 0.61 of LME at a payable ratio of ≈0.95
New scrap per t of copper in semis	0.130	0.100	0.160	C	new (fabrication) scrap arising in the EU per t of copper in semis used in the EU (production less net exports) and in castings: rod drawing and cable making 2-4%, brass turning swarf 35-45%, strip punching 30-40%, tubes ≈5% (≈470 kt); the JRC MFA 2014 new-scrap rate of 25% and the ICA fabrication-scrap share of 28% of demand use other bases
Per-capita inflow vs EU-28 2014	1.00	0.85	1.15	A/C	EU-27 per-capita inflow of copper into use relative to EU-28 2014 (5.91 kg per person, derived from the JRC estimate of copper entering use and the population of the EU-28; Passarini et al. 2018), applied to the historical path 1960-2014
Net imports of copper in finished products, kt	100	−200	300	A/C	net imports of copper contained in finished products into the EU-27, kt Cu (JRC MFA 2014, EU-28: +225 kt)
Per-capita supply 1960 vs 2010	0.670	0.550	0.800	A/C	per-capita copper supply (apparent refined use plus direct melting) in 1960 relative to 2010, EU-28: Ciacci et al. 2017, Tables S1-S2
Inflow growth 2025–2035, per year	0.010	0.000	0.025	C	annual growth of per-capita inflow 2025-2035 (electrification, grids, renewables)
Scaling of product lifetimes	1.00	0.80	1.20	A/C	scaling of mean product lifetimes (JRC: building 40, electrical 25, machinery 18, transport 16, consumer 8 years; SD 0.3 x mean)
Scaling of collection and recovery	1.10	0.95	1.20	A/C	scaling of end-of-life collection and recovery rates by waste stream (Glöser et al. 2013, global 2010) to European levels: EU end-of-life recycling rate about 60% (Ciacci et al. 2017; Soulier et al. 2018)
Propensity to consume	0.860	0.820	0.900	A/C	average propensity to consume out of net labour income; gross household saving rate EU-27 2024 14.67% (Eurostat tec00131)

Parameter	Central	Low	High	Class	Basis and source
Tax rate on labour	0.371	0.355	0.385	A	implicit tax rate on labour, EU-27 2024 (DG TAXUD, Data on Taxation Trends 2026)
Scaling of employment coefficients	1.00	0.90	1.10	C	uncertainty of FIGARO employment coefficients
Taxable share of operating surplus	0.400	0.250	0.550	C	operating surplus net of production taxes, depreciation, interest and losses
Footprint of primary copper, t CO_2e/t	3.64	2.80	3.96	B/A	primary copper cathode, global average, cradle-to-gate: ICA (2023 data, as reported in the Aurubis Environmental Footprint Declaration 2026) 3.64 t CO2e/t; ICA 2019 data 3.965; Nuss and Eckelman 2014 2.8
Direct melting, whole site, t CO_2e/t Cu	0.300	0.200	0.450	B/C	scrap preparation plus melting and casting of directly melted scrap, t CO2e/t Cu (whole-site values per t Cu; upper estimate of the increment over melting cathode)
Secondary smelting and refining, t CO_2e/t Cu	1.00	0.60	1.80	B/C	secondary smelting and refining of scrap and recycling materials in the EU, t CO2e/t Cu: Boliden secondary feed 0.40 (Harjavalta) and 1.35 (Rönnskär), Montanwerke Brixlegg ≈0.63, Nuss and Eckelman 2014 secondary copper at refinery, Europe 1.8
EU grid factor, t CO_2e/MWh	0.183	0.165	0.206	A	EU-27 electricity, t CO2e per MWh: EEA early estimate 2024 183.4 g/kWh (2023: 205.7)
Primary energy, primary copper, GJ/t	53.7	42.1	68.6	A	primary energy, primary copper, GJ/t: Nuss and Eckelman 2014
Primary energy, direct melting, GJ/t	5.00	3.00	8.00	C	additional primary energy of direct melting relative to cathode, GJ/t
Primary energy, secondary refined copper, GJ/t	22.0	17.0	28.1	A/C	primary energy, secondary refined copper, GJ/t; Nuss and Eckelman 2014 secondary 28.1
Tailings per t, t	93.5	84.0	103.0	B/C	t of flotation tailings per t of primary cathode: ICA global 93.5, +/-10%
SO_2 per t, kg	31.2	15.0	35.0	B	kg SO2 per t of primary cathode, ICA global life-cycle inventory
Blue water per t, m^3	57.3	40.0	75.0	B	blue water consumption of primary copper, m3 per t (ICA 2023 LCA)
EU ETS price, EUR/t	64.7	60.0	74.0	A	EU ETS average auction price 2024, EUR 64.74/t (European Commission, Carbon Market Report COM(2025) 735)
Shadow cost of carbon, EUR/t	208	164	314	A	EIB shadow cost of carbon for 2025, EUR 165/t in 2016 prices (European Investment Bank 2020); range 130-250 adopted by IGMNiR; rebased to 2024 prices with the euro-area HICP

Correlated groups (Gaussian copula parameter): copper shares of scrap trade and recovery (ρ = 0.8); primary footprint and primary energy (0.7); metal shares of smelting, semis and cables (0.7); lifetimes and per-capita inflow (−0.3). Copper from direct melting is recomputed in each draw from the copper bridge, and the secondary share of the smelters in NACE 24.44 from secondary refined copper. Fixed inputs: copper price EUR 8,446/t (LME 2025; ECB 2026); mine output 782.3 kt (Reichl and Schatz 2026); refined copper of KGHM 588.7 kt, of which 158.6 kt from scrap; net imports of refined copper 462.5 kt; PRODCOM volumes of semis; copper in net extra-EU exports of unwrought copper alloys (CN 740321 at 60%, 28.5 kt); copper contents of tubes (98%) and castings (75%); population (demo_gind, EUROPOP2023); scenario capacities (Chapter 10).

C Installations of the copper value chain

TABLE 53 Main copper installations in the EU-27

No.	Installation and activity	Location	Segment
1	KGHM mines Lubin, Rudna, Polkowice-Sieroszowice	Lubin–Polkowice (PL)	E0
2	Aitik copper mine (Boliden)	Gällivare (SE)	E0
3	Kevitsa mine (Boliden)	Sodankylä (FI)	E0
4	Proyecto Riotinto (Atalaya Mining)	Minas de Riotinto (ES)	E0
5	MATSA mines Aguas Teñidas, Magdalena, Sotiel (Sandfire)	Almonaster la Real (ES)	E0
6	Neves-Corvo mine (Somincor)	Castro Verde (PT)	E0
7	Assarel-Medet, Ellatzite-Med and Chelopech mines	Panagyurishte–Etropole (BG)	E0
8	KGHM Głogów I and II smelter and refinery	Głogów (PL)	E0
9	KGHM Legnica smelter and refinery	Legnica (PL)	E0
10	Aurubis Hamburg smelter and refinery	Hamburg (DE)	E2/E3
11	Aurubis Lünen recycling smelter	Lünen (DE)	E2/E3
12	Aurubis Pirdop smelter and refinery	Pirdop (BG)	E2/E3
13	Aurubis Olen refinery	Olen (BE)	E2/E3
14	Aurubis Beerse recycling plant	Beerse (BE)	E2/E3
15	Rönnskär smelter (Boliden)	Skelleftehamn (SE)	E2/E3
16	Harjavalta smelter and Pori refinery (Boliden)	Harjavalta (FI)	E2/E3
17	Atlantic Copper smelter and refinery	Huelva (ES)	E2/E3
18	Montanwerke Brixlegg (secondary)	Brixlegg (AT)	E2/E3
19	Wieland – copper and copper-alloy semis	Ulm (DE)	E4
20	KME – copper and copper-alloy semis	Osnabrück (DE)	E4
21	Aurubis Stolberg – strip and specialty wire	Stolberg (DE)	E4
22	KME Mansfeld – copper and brass semis	Hettstedt (DE)	E4
23	ElvalHalcor – copper tubes and semis	Oinofyta (GR)	E4
24	La Farga – wire rod from scrap	Les Masies de Roda (ES)	E4
25	Brass rod mills of the Brescia district	Brescia (IT)	E4
26	TFKable – cables	Kraków (PL)	E5
27	Prysmian – cable plant	Arco Felice (IT)	E5
28	Aguablanca (extraction), CRMA 2025	Monesterio (ES)	outside model
29	Sakatti (extraction and processing), CRMA 2025	Sodankylä (FI)	outside model
30	Rovina (extraction), CRMA 2025	Hunedoara (RO)	outside model
31	Skouries (extraction), CRMA 2026	Chalkidiki (GR)	outside model
32	Viscaria (extraction), CRMA 2026	Kiruna (SE)	outside model
33	Retków-Grodziszcze deposit (KGHM), CRMA 2026	Głogów (PL)	outside model
34	Hautalampi Co-Ni-Cu mine (extraction), CRMA 2026	Outokumpu (FI)	outside model
35	Myne Circular Metals (recycling), CRMA 2026	Harderwijk (NL)	outside model
36	GALLICAM (processing), CRMA 2025	Sandouville (FR)	outside model

Locations at town level. The list covers major mines, smelters, refineries, semi-fabricators and cable makers identified in company reports (among others Aurubis 2025a; KGHM 2025a, 2025b; Boliden 2025; TFKable 2025) and EU documents (European Commission 2025a, 2026a) of 2024–2026; it is not exhaustive. KGHM smelters and refineries are part of a mining enterprise (NACE 07.29, segment E0). CRMA strategic projects are listed for information and are outside the 2024 model.

D Glossary

- **Potentially avoided burden** – environmental credit for displacing primary production with secondary material, conditional on the substitution assumed.
- **Coverage ratio** – EU supply or output relative to EU use; not a measure of self-sufficiency.
- **CRMA** – Critical Raw Materials Act, Regulation (EU) 2024/1252; copper is a strategic and a critical raw material; 2030 benchmarks: extraction 10%, processing 40%, recycling 25% of EU consumption, at most 65% from one third country.
- **Copper first used** – refined copper used in the EU plus copper from scrap melted directly (3,626 kt in 2024); the denominator of the secondary share. It differs from copper contained in semis and castings (3,538 kt) by refined copper used outside semis and castings and by the bridge terms.
- **Direct melting** – melting of clean copper and copper-alloy scrap by semis producers and foundries without refining to cathode.
- **Dynamic material-flow model** – model that tracks copper entering use by year and end use and its release at end of life after a distributed product lifetime.
- **End-of-life recycling rate (EoL-RR) / end-of-life recycling input rate (EoL-RIR)** – share of copper in end-of-life products that is recovered / share of copper from end-of-life scrap in the copper input to production.
- **E-scrap** – waste electrical and electronic equipment and its fractions (printed circuit boards) processed for copper and precious metals.
- **Extra-EU / intra-EU trade** – trade of member states with countries outside the EU / with other member states; CU-EU treats intra-EU deliveries as domestic.
- **FIGARO** – EU inter-country supply, use and input-output tables of Eurostat; aggregated in CU-EU to one EU-27 block.
- **SIOT** – symmetric input-output table (product by product); the EU-27 table of Eurostat (naio_10_cp1700) is used for validation.
- **TBRC / KRS** – top-blown rotary converter / Kayser recycling system: furnaces for secondary copper smelting of scrap and residues.
- **Compensation of indirect emission costs** – state aid for emission costs passed through in electricity prices (Directive 2003/87/EC, Art. 10a(6)).
- **GVA** – gross value added: output minus intermediate consumption; from structural business statistics at factor cost.
- **Gross contribution / net effect** – activity associated with the chain at fixed coefficients / change that would result from a policy or shock after resources are reallocated; the report shows gross contributions only.
- **HHI** – Herfindahl–Hirschman index of concentration (0–10,000).
- **New and old scrap** – scrap from fabrication of semis and products / scrap from products at the end of their life. The new-scrap rate (r_new) is new scrap per tonne of copper in semis used in the EU and in castings.
- **Observation / estimate / model result (O/E/M)** – status of a figure: published data / data combined with allocations or calibrated parameters / result depending on counterfactual or dynamic assumptions.
- **Type I / Type II effects** – direct plus supply-chain effects / plus effects induced by household spending.

References

American Chamber of Commerce in Bulgaria (AmCham Bulgaria) (2024), Ellatzite-Med AD plans to invest over BGN 1.2 billion to expand copper production, 5 March 2024. Sofia.

Asarel-Medet AD (undated), Production results: asarel.com (accessed 10 November 2026). Panagyurishte.

Atalaya Mining (2025), Q4 2024 operations update (14 January 2025) and 2024 annual results (18 March 2025). Nicosia.

Aurubis AG (2024), Company Release fiscal year 2023/24, 5 December 2024. Hamburg.

Aurubis AG (2025a), Annual Report 2024/25. Hamburg.

Aurubis AG (2025b), Quarterly Report Q1 2024/25 (October–December 2024). Hamburg.

Aurubis AG (2026), Environmental Footprint Declarations – copper cathode and copper wire rod, status October 2026. Hamburg.

Boliden AB (2021), Carbon footprint of Boliden's main metals – executive summary, with assurance statement by Intertek. Stockholm.

Boliden AB (2025), Interim Report Q4 and Year-end Report 2024 (6 February 2025). Stockholm.

British Geological Survey (BGS) (2025), World Mineral Production 2019–2023. Keyworth, Nottingham.

Ciacci L., Fishman T., Elshkaki A., Graedel T.E., Vassura I., Passarini F. (2020), Exploring future copper demand, recycling and associated greenhouse gas emissions in the EU-28. Global Environmental Change 63: 102093 (doi:10.1016/j.gloenvcha.2020.102093).

Ciacci L., Vassura I., Passarini F. (2017), Urban mines of copper: size and potential for recycling in the EU. Resources 6(1): 6 (doi:10.3390/resources6010006).

Commission Delegated Decision (EU) 2019/708 of 15 February 2019 supplementing Directive 2003/87/EC concerning the determination of sectors and subsectors deemed at risk of carbon leakage for the period 2021 to 2030. OJ L 120, 8.5.2019.

Commission Implementing Regulation (EU) 2026/1412 of 26 June 2026 determining revised benchmark values for free allocation of emission allowances for the period 2026 to 2030. OJ L, 29.6.2026.

Communication from the Commission – Framework for State aid measures to support the Clean Industrial Deal (Clean Industrial Deal State Aid Framework, CISAF), C/2025/3602. OJ C, 4.7.2025.

Communication from the Commission – Guidelines on certain State aid measures in the context of the system for greenhouse gas emission allowance trading post-2021 (2020/C 317/04). OJ C 317, 25.9.2020.

Congressional Research Service (CRS) (2026), Section 232 National Security Tariffs on Copper Imports, Insight IN12614, updated 23 April 2026. Washington, DC.

Copper Development Association (CDA) (undated), Economic impact of copper: copper.org/economy (archived version; accessed 10 November 2026). McLean, VA.

Deutsche Emissionshandelsstelle (DEHSt) (2026), Auswertungsbericht Strompreiskompensation 2024 (SPK-Bericht 2024). Berlin: Umweltbundesamt.

Diehl Stiftung & Co. KG (2025), Annual Report 2024. Nuremberg.

Directive 2003/87/EC of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union (consolidated text). OJ L 275, 25.10.2003.

Dundee Precious Metals Inc. (2025), fourth quarter and full year 2024 results, news release of 13 February 2025. Toronto.

European Central Bank (2026), Euro foreign exchange reference rates, US dollar annual average (EXR.A.USD.EUR.SP00.A). Frankfurt am Main.

European Commission (2023), Study on the critical raw materials for the EU 2023 – Final report. Luxembourg: Publications Office of the European Union.

European Commission (2025a), Commission Decision (EU) 2025/840 of 25 March 2025 on the recognition of strategic projects under Regulation (EU) 2024/1252 (C(2025) 1904), OJ L, 30.4.2025; and press release IP/25/864 of 25 March 2025. Brussels.

European Commission (2025b), A European Steel and Metals Action Plan, COM(2025) 125 of 19 March 2025. Brussels.

European Commission (2025c), RESourceEU Action Plan: Accelerating our critical raw materials strategy to adapt to a new reality, COM(2025) 945 of 3 December 2025. Brussels.

European Commission (2025d), Report on the functioning of the European carbon market in 2024 (Carbon Market Report), COM(2025) 735 of 3 December 2025. Brussels.

European Commission (2025e), Carbon Border Adjustment Mechanism package of 17 December 2025: press release IP/25/3088 and proposal COM(2025) 989 extending the CBAM to downstream products. Brussels.

European Commission (2025f), Commission introduces surveillance of imports and exports of metal scrap, news of 23 July 2025. Brussels.

European Commission (2026a), press release IP/26/2113 of 9 October 2026 on the second list of Strategic Projects under the Critical Raw Materials Act, with questions and answers QANDA/26/2114 and factsheet FS/26/2115. Brussels.

European Commission (2026b), Communication from the Commission amending the Guidelines on certain State aid measures in the context of the system for greenhouse gas emission allowance trading post-2021, C/2026/196. OJ C, 5.1.2026.

European Commission (2026c), Union Registry: verified emissions of stationary installations, file verified_emissions_2025_en.xlsx (extraction of 1 April 2026). Brussels: DG CLIMA.

European Commission (2026d), Proposal for a Regulation (Industrial Accelerator Act), COM(2026) 100 of 4 March 2026, procedure 2026/0068(COD). Brussels.

European Commission, DG TAXUD (2026), Data on Taxation Trends, 2026 edition (implicit tax rate on labour, EU-27). Luxembourg.

European Copper Institute (ECI) (undated), Europe's copper industry: copperalliance.eu/about-us/europes-copper-industry (accessed 10 November 2026). Brussels.

European Environment Agency (2026), Greenhouse gas emission intensity of electricity generation in Europe (indicator; early estimate for 2024). Copenhagen.

European Investment Bank (2020), EIB Group Climate Bank Roadmap 2021–2025. Luxembourg.

Eurostat (2026a), FIGARO – EU inter-country supply, use and input-output tables, 2024 (naio_10_fcp_ip4), edition of July 2026; symmetric input-output table of the EU-27 (naio_10_cp1700), 2021–2023. Luxembourg.

Eurostat (2026b), Structural business statistics (sbs_ovw_act), national accounts (nama_10_a64, nama_10_a64_e), PRODCOM (DS-059358), Comext (DS-045409), population (demo_gind, demo_pjan), population projections EUROPOP2023 (proj_23np), electricity prices for non-household consumers (nrg_pc_205) and household saving rate (tec00131), as available on 31 October 2026. Luxembourg.

Federal Register (2025), Proclamation 10962 of 30 July 2025, Adjusting Imports of Copper Into the United States, 90 FR, 5 August 2025 (document 2025-14893). Washington, DC.

Freeport-McMoRan Inc. (2025), Annual Report on Form 10-K for the fiscal year ended 31 December 2024 (filed 14 February 2025). Phoenix, AZ.

Glöser S., Soulier M., Tercero Espinoza L.A. (2013), Dynamic analysis of global copper flows. Global stocks, postconsumer material flows, recycling indicators, and uncertainty evaluation. Environmental Science & Technology 47(12): 6564–6572 (doi:10.1021/es400069b).

Gregoir L., Van Acker K. (2022), Metals for Clean Energy: Pathways to solving Europe's raw materials challenge. Policymaker summary, KU Leuven for Eurometaux, April 2022. Leuven.

IGMNiR (2026a), Copper in the German economy: value, circularity and security of supply (CU-DE model). Warsaw: Economic Chamber of Non-Ferrous Metals and Recycling.

IGMNiR (2026b), Copper in the Italian economy: value, circularity and security of supply (CU-IT model). Warsaw: Economic Chamber of Non-Ferrous Metals and Recycling.

IGMNiR (2026c), Copper in the Polish economy: value, circularity and security of supply (CU-PL model). Warsaw: Economic Chamber of Non-Ferrous Metals and Recycling.

International Copper Association (2023a), Copper – The Pathway to Net Zero: Regional Focus Europe. Washington, DC.

International Copper Association (2023b), Copper Environmental Profile – Global 2023. Washington, DC.

International Copper Association, International Wrought Copper Council, Copper Development Association (2024), Copper and Copper Alloy Semi-Fabricated Products LCA 2024. Washington, DC.

International Copper Study Group (2026), The World Copper Factbook 2026. Lisbon.

International Energy Agency (IEA) (2025), Global Critical Minerals Outlook 2025. Paris.

KGHM Polska Miedź S.A. (2025a), Management Board's Report on the activities of KGHM Polska Miedź S.A. and the KGHM Polska Miedź S.A. Group in 2024. Lubin.

KGHM Polska Miedź S.A. (2025b), Preliminary production and sales data, December 2024 (24 January 2025). Lubin.

KME Group S.p.A. (2025), Annual Financial Report 2024 (incl. consolidated data of KME SE). Milan.

Kulczycka J., Mańka M., Generowicz-Caba N. (2026), Conducting an analysis of the environmental footprint and carbon footprint for KGHM Polska Miedź S.A. products, including the preparation of environmental declarations. Kraków; published by KGHM Polska Miedź S.A.

La Farga Yourcoppersolutions S.A. (2023), Environmental Product Declaration – Genius copper wire rod (Cu-FRHC), S-P-02032, revision of 20 December 2023. Stockholm: EPD International.

London Metal Exchange (2025), LME copper official settlement prices, 2024 annual average. London.

Lundin Mining Corporation (2025), production results for 2024, news release of 16 January 2025. Vancouver.

Ministry of Ecology and Environment of the People's Republic of China (MEE) et al. (2024), Announcement No. 23 of 2024 on the import management of recycled copper, copper-alloy, aluminium and aluminium-alloy raw materials (in force from 15 November 2024). Beijing.

Nuss P., Eckelman M.J. (2014), Life cycle assessment of metals: a scientific synthesis. PLoS ONE 9(7): e101298 (doi:10.1371/journal.pone.0101298).

Näringslivsregistret (2026), Boliden Mineral AB, org. no. 556231-6850: SNI codes 07290 (main), 24440, 24410, 20130, 72190 (from the business register of Statistics Sweden; accessed 10 November 2026).

Oxford Economics (2019), The Impact of the European Steel Industry on the EU Economy: an updated and extended analysis. Report for EUROFER, July 2019. London.

Passarini F., Ciacci L., Nuss P., Manfredi S. (2018), Material flow analysis of aluminium, copper, and iron in the EU-28. JRC Technical Reports, EUR 29220 EN. Luxembourg: Publications Office of the European Union (doi:10.2760/1079).

Regulation (EU) 2023/956 of 10 May 2023 establishing a carbon border adjustment mechanism. OJ L 130, 16.5.2023.

Regulation (EU) 2024/1157 of 11 April 2024 on shipments of waste. OJ L, 30.4.2024.

Regulation (EU) 2024/1252 of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials. OJ L, 3.5.2024.

Reichl C., Schatz M. (2026), World Mining Data 2026, Volume 41. Vienna: Austrian Federal Ministry of Finance.

Reuters (2023), Antofagasta agrees lower 2024 copper charges with Chinese smelter at $80 per ton, November 2023.

Reuters (2024), Antofagasta, Jiangxi agree major drop in 2025 copper TC/RCs, 6 December 2024.

Reuters (2025), Antofagasta agrees zero copper processing charges for 2026 with Chinese smelter, 19 December 2025.

S&P Global (2026), Copper in the Age of AI: The Challenges of Electrification, January 2026; press release of 8 January 2026. New York.

Sandfire Resources Ltd (2025), quarterly activity reports for the quarters ended March, June, September and December 2024 (ASX releases of 30 April 2024, 25 July 2024, 29 October 2024 and 30 January 2025). Perth.

SCRREEN2 (2023), Factsheets updates based on the EU factsheets 2023: Copper. Horizon 2020 project SCRREEN2 (grant 958211).

Soulier M., Glöser-Chahoud S., Goldmann D., Tercero Espinoza L.A. (2018), Dynamic analysis of European copper flows. Resources, Conservation and Recycling 129: 143–152 (doi:10.1016/j.resconrec.2017.10.013).

Tele-Fonika Kable S.A. (TFKable) (2025), ESG Report 2024 (3 October 2025). Kraków.

U.S. Geological Survey (2026), Mineral Commodity Summaries 2026 – Copper. Reston, VA.

UMCOR AG (undated), Montanwerke Brixlegg: company profile (incl. Kovohuty a.s., Krompachy): umcor.ch (accessed 10 November 2026). Zug.

Viohalco S.A. (2025), Annual Report 2024. Brussels.

Wieland-Werke AG (2024), Nachhaltigkeitsbericht 2023/24. Ulm.

IGMNiR

Economic Chamber of Non-Ferrous Metals and Recycling

Economic Chamber of Non-Ferrous Metals and Recycling

Izba Gospodarcza Metali Nieżelaznych i Recyklingu

CU-EU is a transparent, reproducible model linking official EU statistics, company financial and environmental reports, the EU emissions registry, published product footprints, a dynamic model of copper in use and the process metallurgy of copper. It estimates the gross economic and fiscal contribution of the copper industry in the European Union – copper mining, collection and trade of scrap, secondary and primary smelting and refining, semis, castings and cables – the emissions and other burdens potentially avoided by secondary copper, and the industry's importance for the security of supply.

SUGGESTED CITATION

IGMNiR (2026), Copper in the EU-27 economy: value, circularity and security of supply. An integrated assessment of the copper industry in the European Union (CU-EU model). Economic Chamber of Non-Ferrous Metals and Recycling, November 2026.