Copper: The strategic, circular, and sustainable raw material of the HVACR industry

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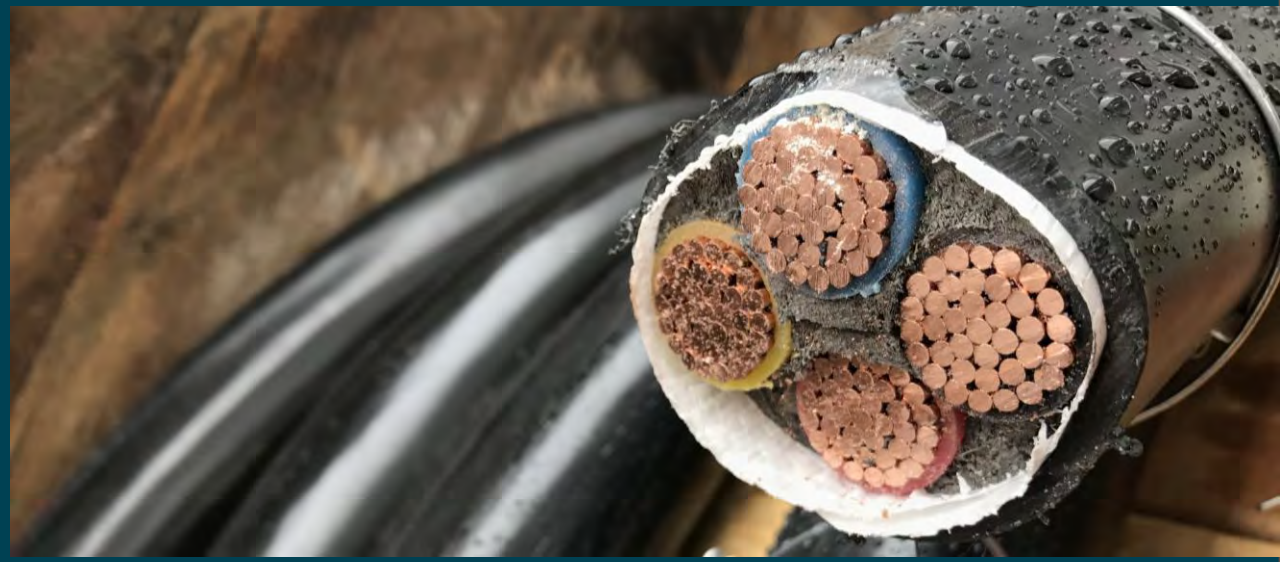
Electrification: Relying on copper's superior properties

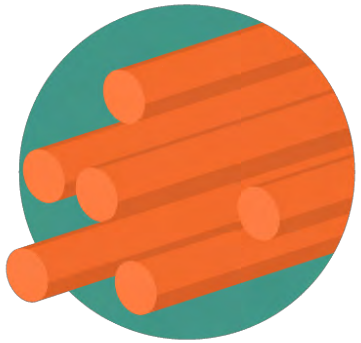
Excellent Electrical & Thermal Conductivity

Metal	Electrical (IACS)	Thermal (W/m.k)
Silver	105%	430
Copper	**101%**	**401**
Gold	70%	310
Aluminium	61%	237



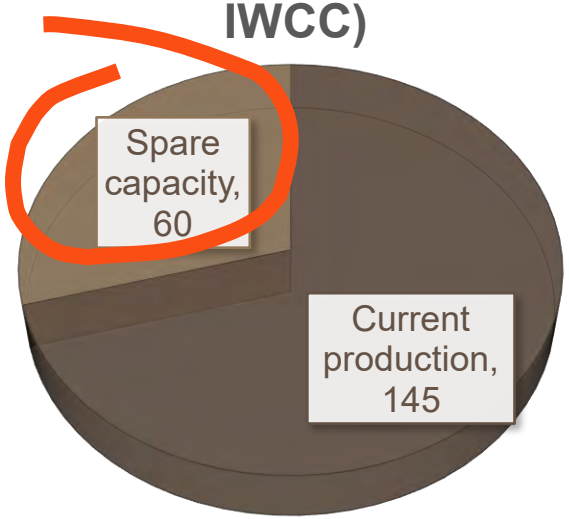
Superior properties

- Low coefficient of thermal expansion
- Highly corrosion-resistant
- Machinability (brazing, bending)
- Mechanical performance (fatigue and creep resistance)
- Sustainability and circular economy benefits, high recyclability



Copper tube production well established in Europe

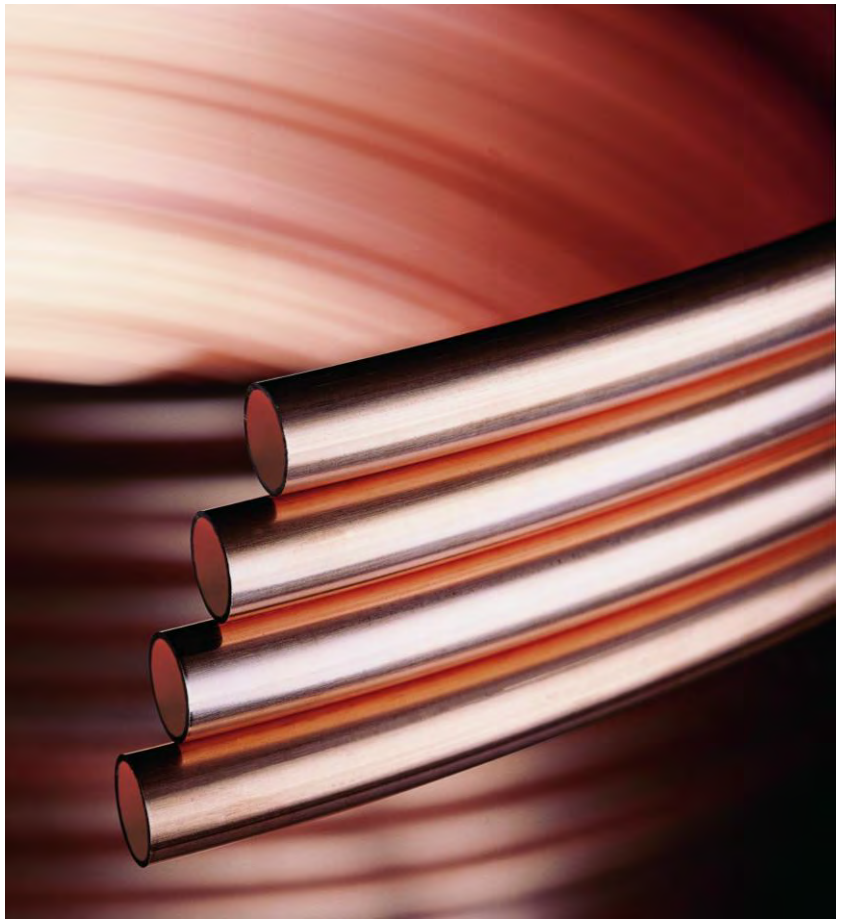
INDUSTRIAL COPPER TUBE PRODUCTION CAPACITY IN EU (205KTPA IN 2024, SOURCE IWCC)



Sustainability

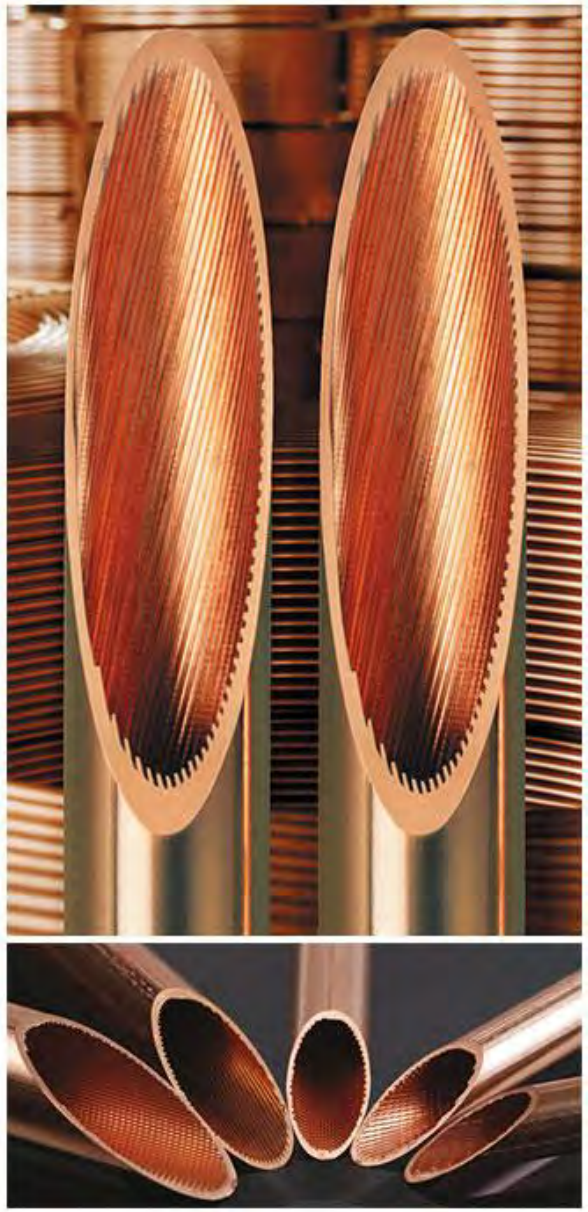
- Good potential of the use of recycled material
- The carbon footprint of European tubes is continuously improved, contributing to better life-cycle data of final products

Global avg: 2.763 $kgCO_2$ eq/kg
European ex.: 0,515 $kgCO_2$ eq/kg



Small diameter inner grooved copper tube

- Innovative copper tubes suitable for refrigerant-to-air heat exchangers, including evaporators, condensers and gas coolers
- European suppliers available
- Key advantages:
  - Well suited for new refrigerants, uses less refrigerant (F-gas regulation)
  - Smaller size, less weight and lower material costs
  - Cost-effective fabrication and assembly
  - Higher heat transfer coefficients
  - Overall reduction in system costs



Most of EU copper demand is met by domestic smelting, refining and recycling capacity

~20%
Copper extracted and processed in the EU

~50%
Recycling in the EU (refining and direct melt)

~20%
Processing in the EU of imported copper concentrate

~10%
Imported refined copper

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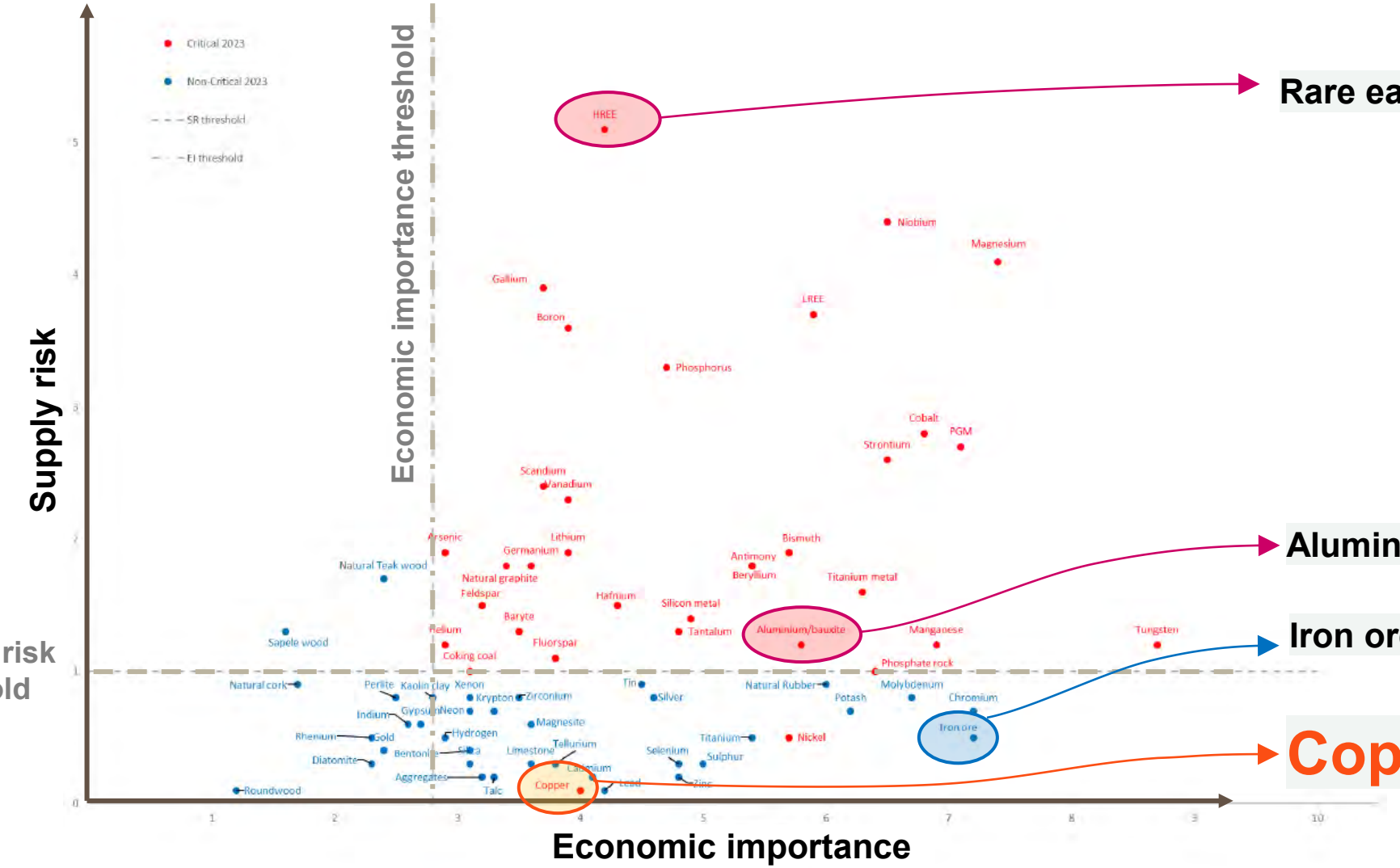
Figures of 2022, Sources: ICSG, IWCC, ICA Stocks & flows model, and own calculations, rounded numbers considering net imports or exports

Study on the Critical Raw Materials for the EU 2023

Final Report

Critical raw materials assessment – EU 2023



Supply risk threshold

Rare earths

Aluminium / Bauxite

Iron ore

Copper

Cu

Study on the critical raw materials for the EU 2023
https://op.europa.eu/en/publication-detail/-/publication/57318397-fdd4-11ed-a05c-01aa75ed71a1

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Copper already meets Critical Raw Materials Act thresholds

European Commission

	Extraction	Processing & Refining	Recycling	Dependency of a single country
				
CRM Act 2030 targets for self-sufficiency	**>10%**	**>40%**	**>25%**	**<65%**
Copper (2020)	**~ 50%** (ore & concentrate)	**~ 90%** (refined)	**~ 50%**	
Aluminium	**~ 11%** (bauxite)	**~ 42%** (aluminium)	**~ 32%**	

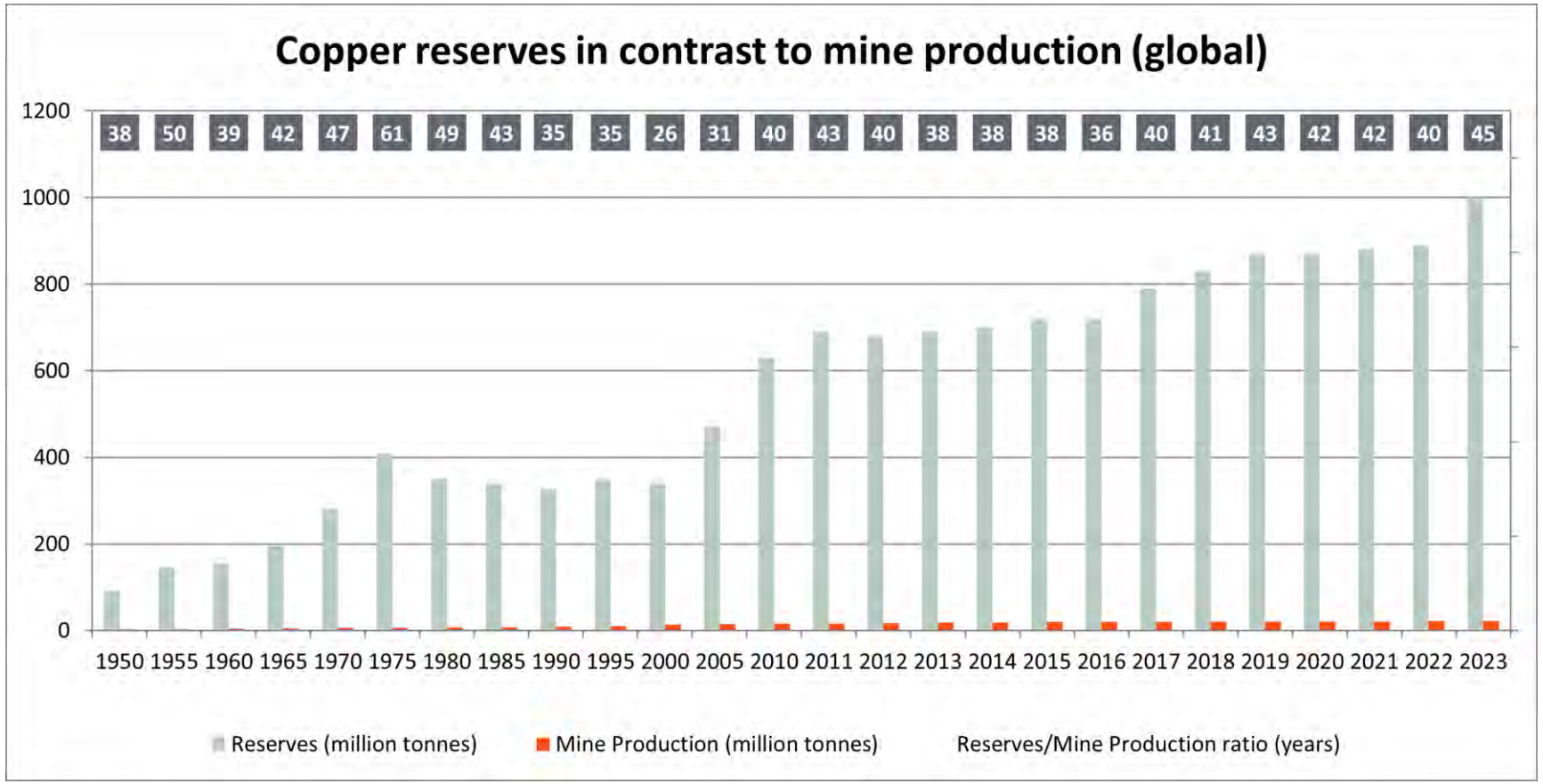
Largest supply sources for the EU

	Mining	*Refining*
Copper (2020)	Poland (19%) Chile (14%) Peru (10%)	Germany (17%) Poland (14%) Spain (11%)
Aluminium	Guinea (63%) Brazil (12%) Greece (10%)	Russia (19%) Germany (10%) Mozambique (9%)

Cu

Source: Study on the critical raw materials for the EU 2023, European Commission, 2023 (https://op.europa.eu/s/z8yV)

Copper reserves have consistently averaged a 40-year supply



Since 1950, there has always been, on average, **40 years of copper reserves** and over 200 years of resources remaining.

Source: https://internationalcopper.org/sustainable-copper/about-copper/cu-demand-long-term-availability/ according to United States Geological Survey 2023

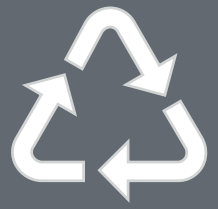
ICA members are committed to increasing capacity in a sustainable way

Commitment to bringing scope 1 and 2 GHG emissions to net zero by 2050 and increase recycling

Leading assurance framework to promote responsible practices across the copper, molybdenum, nickel and zinc value chains

THE COPPER MARK | RESPONSIBLY PRODUCED COPPER

Recycling of copper



Copper can be recycled repeatedly without loss of properties

Recycling won't suffice! Meeting the growing demand requires mining, recycling, and trade

Improving design for recyclability and EoL collection are the priorities

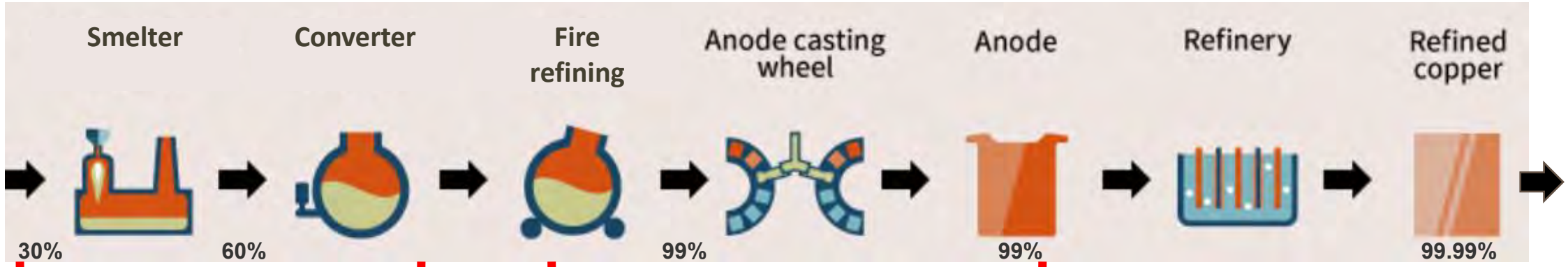
Avoid the pitfall of Recycled Content requirements

Circularity: our society holds a massive urban copper mine

2/3 of all copper produced since 1900 is still in use,

it represents ~ 470 Mt (2024)

Recycling route depends on scrap purity and on product requirements, but same end purity can be reached with the right process



Scrap grade

<85% Cu

Smelting, converting & Refining

85% - 98% Cu

Refining (fire / electro)

>99% Cu

Melting

Directly returned to fabrication (depending on product requirement)

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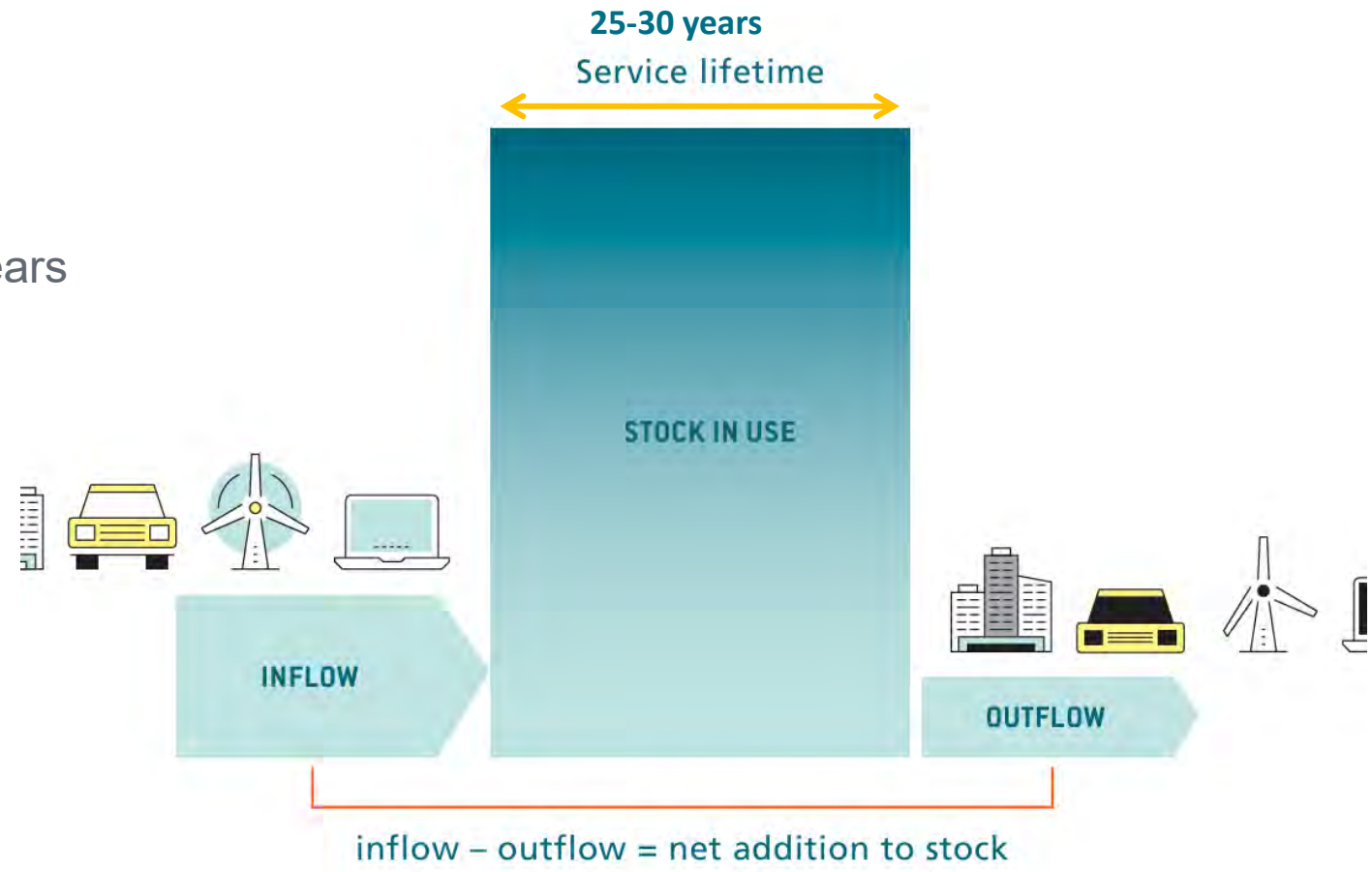
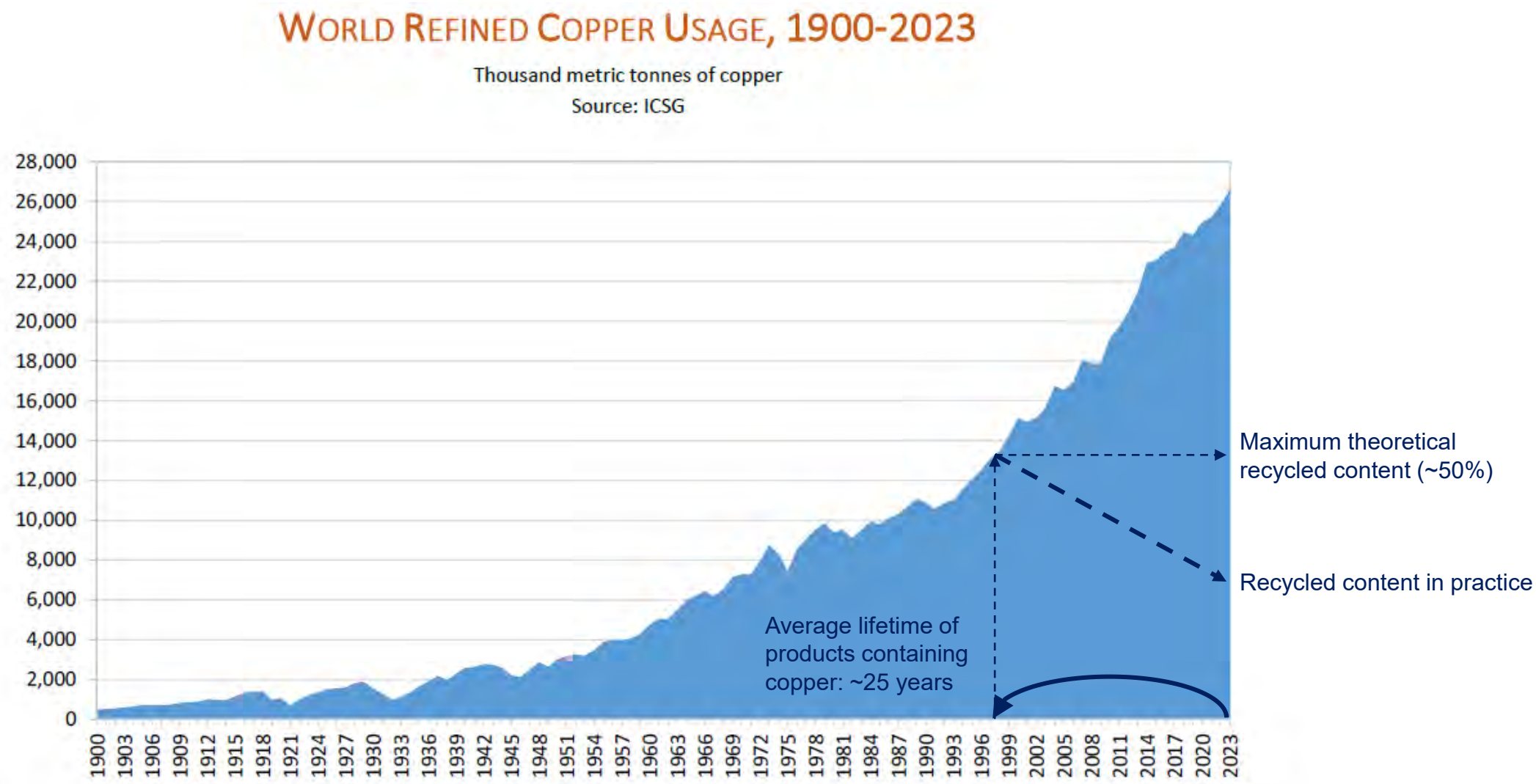
The long lifetime in use and the historical growing demand limits the potential availability of secondary material

- Copper demand roughly doubles every 25 years
- Average lifetime in use is 25-30 years



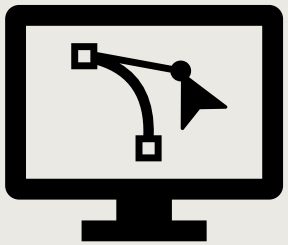
Recycled copper content: practical limits



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

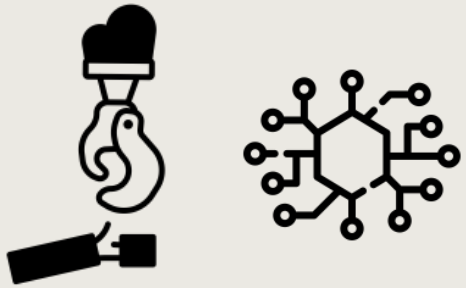
Source: The World Copper Factbook 2024 https://icsg.org/copper-factbook/

Factors affecting scrap availability



Design-for-sustainability

Incentives to improve collection rates



Progress in sorting technologies
Trained AI systems
Innovative shredding

Increasing product complexity

Policies requiring more durable products, longer lifetimes

Copper is a strategic material. It is not critical because its supply is very well diversified

Primary copper is on the path to net zero

Copper is strongly recyclable, but recycling won’t suffice

Securing EU copper’s supply requires to boost mining, refining, recycling and global partnerships

Cu

International Copper Association

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