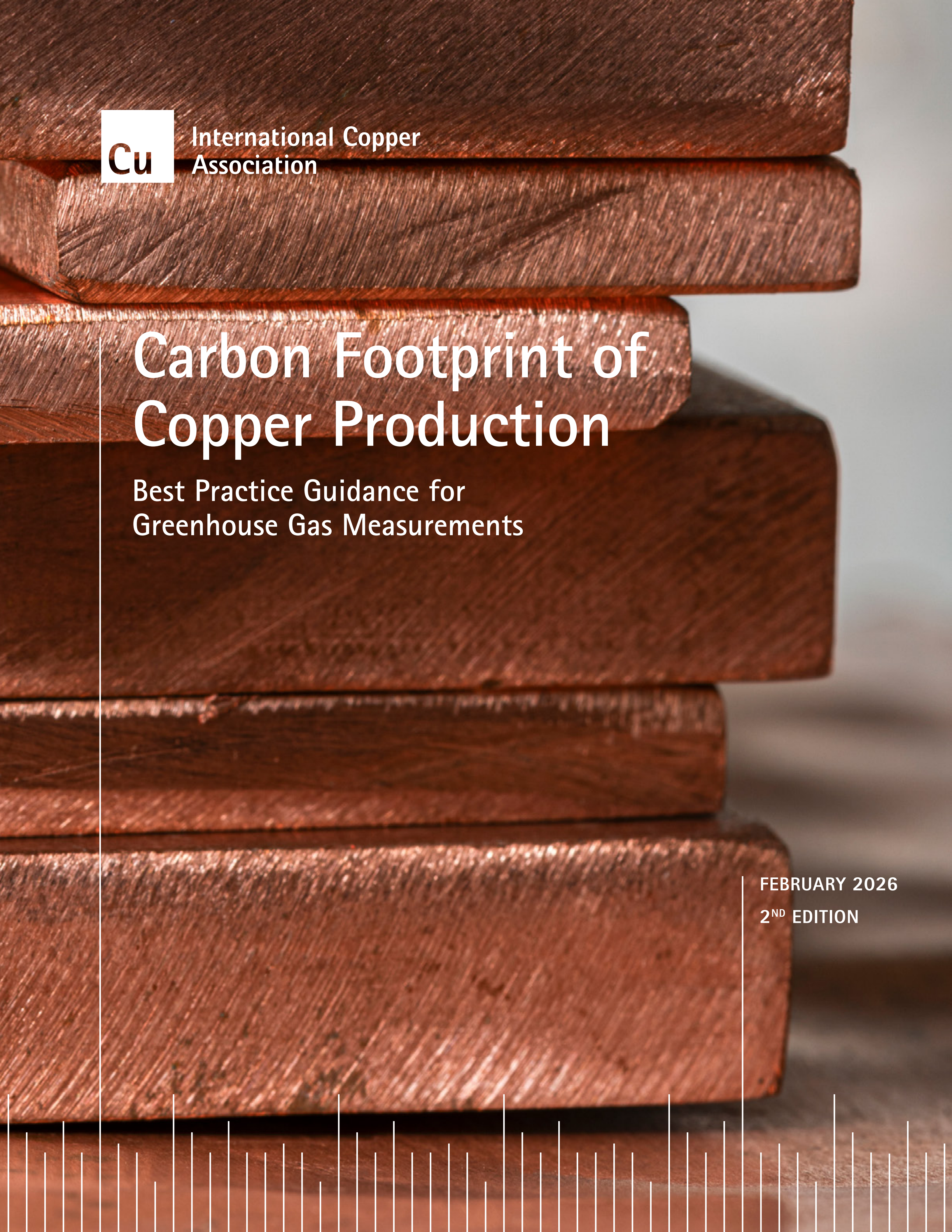

International Copper Association

Carbon Footprint of Copper Production

Best Practice Guidance for Greenhouse Gas Measurements

FEBRUARY 2026

2ND EDITION

Acknowledgements

Version 2 of these Guidelines was produced by the International Copper Association's Ladji Tikana, Bethany Perkins and Louise Assem with input from ICA's Life Cycle Assessment Task Force. Version 1 of this guidance was published in October 2022.

The design and layout was prepared by Bethany Perkins and Annatto.

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INTRODUCTION

Greenhouse gas (GHG) emissions are the major driver for climate change, one of the **biggest challenges of our time**.

According to ICA analysis on 2023 data and the Copper Mark, copper production represents approximately 0.2% of global GHG emissions. While this contribution to global GHG emissions is currently low, copper demand is expected to double by 2050, driven in part by the need for copper for the clean energy transition. Given this awareness, copper miners and producers recognize that they have a responsibility to mitigate GHG emissions, and many companies have made commitments to, and are engaged in, reducing their GHG emissions. The measurement of GHG emissions is therefore an important step in understanding total emissions affecting climate change and identifying hot spots where significant GHG emissions occur.

Accurate and consistent measurement allows companies to both demonstrate and measure efforts in reducing GHG emissions, and determine their contribution to climate change mitigation.

Efforts by companies to reduce GHG emissions at corporate, site, and product level, must be supported by robust, reliable and transparent methods and data to enable those companies to accurately track progress towards decarbonization, to report carbon footprint (CF) data along the supply chain to direct customers and to downstream OEMs using copper products, and to report to market initiatives like the London Metals Exchange's (LME) LMEpassport and Copper Mark that are

asking for CF disclosures. Companies also need to prepare for new regulations that may require CFs. Harmonized methodologies for determining the CFs of products and organizations can support and facilitate a level playing field for reporting and disclosure.

This best practice guidance was developed to provide a harmonized and consistent approach for determining the CF in the copper sector and to facilitate consistent reporting by copper miners and producers.

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EXISTING METHODS AND STANDARDS

This best practice guidance document is based on the ISO 14040/44 life cycle assessment standards and the ISO 14067 product carbon footprint standard. It also draws on the following reference materials as indicated:

- WRI/WBCSD's GHG Protocol Scope 1, 2 and 3 Guidance
- WRI/WBCSD's GHG Protocol Product Life Cycle Accounting and Reporting Standard
- Organisation Environmental Footprint Sector Rules: Copper Production

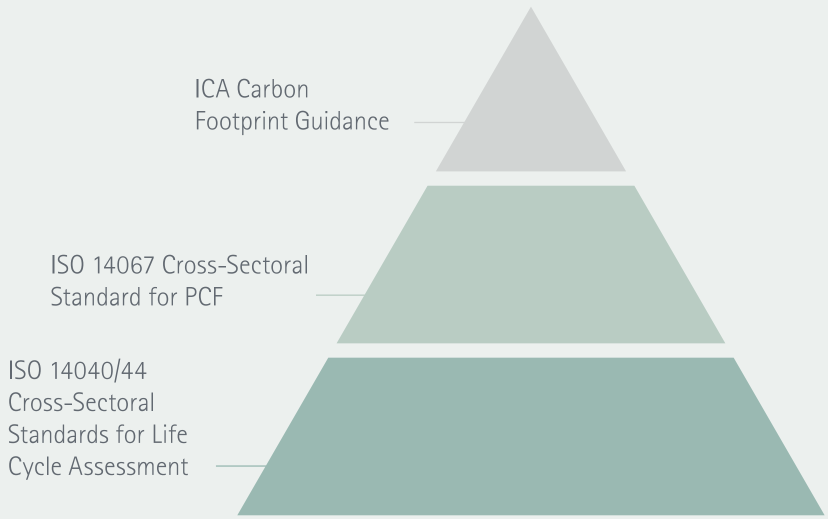

Figure 1: Relationship of standards.

It is mostly aligned with the following accounting and reporting guidances:

- Copper Mark Standard
- EU Environmental Footprint (Product and Organization)
- EU Corporate Sustainability Reporting Directive,
- WBCSD Partnership for Carbon Transparency (PACT): Methodology for calculating and exchanging cradle-to-gate product carbon footprints (PCFs)

The goal of this guidance is to provide all stakeholders with a harmonized and consistent approach for calculating the CF for refined copper and its intermediate products, including concentrate.

GOAL AND SCOPE

The goal of this guidance is to provide all stakeholders with a harmonized and consistent approach for calculating the CF for refined copper and its intermediate products, including concentrate. The impact includes the summation of all GHG emissions over the production stages of the relevant product from cradle to gate. The guidance covers all production routes (pyrometallurgical, hydrometallurgical and secondary) and associated precursor products, including copper concentrates (see **Figure 5**) and ensures that data communicated by copper producers are based on the same calculations, methods, and parameters (see **Section 5, Harmonized Carbon Accounting, Activity Data**). Because different LCA/CF background data sources (e.g. for purchased electricity, transport processes etc.) may still be used, direct comparability cannot be ensured. Semi fabrication of products, which takes place after the cathode production step, is not included in this guidance.

GHG EMISSIONS MEASUREMENT

The CF of products (PCF) is expressed in CO_2 equivalents (CO_2eq; an indicator of climate change impact) per kg of copper with the option to also report in metric tons of refined copper metal and includes, besides carbon dioxide (CO_2), impacts from other gases that contribute to climate change (**Table 1** lists the emissions factors for some major GHGs). ICA recommends using the latest United Nations (UN) Intergovernmental Panel on Climate Change (IPCC) emissions factors for converting the life cycle inventory results into CO_2eq for all GHGs, at the time of publication those listed in **Table 1** align with the IPCC Sixth Assessment Report, published in 2024 (accessible here: IPCC, 2024). Emissions to air, water or/and soil that do not have the potential to contribute global warming directly, are not considered in this guidance. An organization's carbon footprint i.e., corporate carbon footprint (CCF) is expressed as the total greenhouse gas (GHG) emissions, measured in tonnes of carbon dioxide equivalent, typically over a one-year period.

Gas Name	Chemical Formula	Global Warming Potential (GWP) for 100-Year Time Horizon
Carbon dioxide	CO_2	1
Methane – non-fossil	CH_4	27.0
Methane – fossil	CH_4	29.8
Nitrous oxide	N_2O	273
Nitrogen trifluoride	NF_3	17,400
Sulfur hexafluoride	SF_6	24,300

TABLE 1: List of some Major Greenhouse Gases (GHG) and their characterization factors (IPCC, 2024)

The most common, globally accepted framework methodology available to measure climate change potential (or global warming potential; GWP) and other environmental impacts, is environmental life cycle assessment (LCA).

1 Greenhouse Gas Protocol Standards. https://ghgprotocol.org/standards.

The WRI/WBCSD's GHG Protocol provides the world's most widely accepted method of carbon accounting for companies and organizations[1]. The GHG Protocol is consistent with IPCC guidelines for national GHG inventories and with the ISO GHG emissions reporting standard (ISO 14064-1). The International Council for Mining and Metals (ICMM) has published a sector-specific guidance on carbon accounting for the metals and mining sector that builds and expands upon the GHG Protocol Standards. For organizational guidance specific to the copper sector refer to the Organizational Environmental Footprint Sector Rules. When assessing the carbon footprint of an organization, these rules should be used.

The most common, globally accepted framework methodology available to measure climate change potential (or global warming potential; GWP) and other environmental impacts, is environmental life cycle assessment (LCA). LCA methodology involves analyzing the potential environmental impacts of services and products over their entire life cycle (e.g. from raw material extraction through manufacturing, distribution, use, and end of life disposal) or a subset of their life cycle. LCAs provide data and information on many environmental impact categories, including the climate change impact category (carbon footprint). LCA specifies the principles, requirements and methodologies for quantifying and communicating GHG emissions from refined copper metal production processes and the associated cradle-to-gate CFs. This guidance is based on ISO 14044 standard on environmental management – life cycle assessments – requirements and guidelines, which represents a general framework and guidance for all products and systems and is not specific to the copper industry and its characteristics.

LCA typically aggregates Scope 1, Scope 2, and Scope 3 emissions on a per product or organization basis. In this way LCA and GHG accounting are related. As per WRI, "The sum of the life cycle emissions of each of a company's products, combined with additional Scope 3 categories (e.g., employee commuting, business travel, and investments), should approximate the company's total corporate GHG emissions (i.e., Scope 1 + Scope 2 + Scope 3)."[2]

The application of this guidance allows producers of copper concentrates and refined copper producers as well as their customers and other stakeholders to calculate the climate change impact of refined copper production and its intermediate products e.g., concentrates. For reasons of comparability, inputs and outputs that are likely to be GHG-linked for each unit process identified are to be processed. While the activities may differ between companies, accounting for all emission sources will ensure comparability between similar companies. To determine the extent to which inventories are comparable, a review of the material categories included in the inventory should be performed and companies should transparently disclose emission categories reported and include justification for any sources not included within the inventory.

No matter which system boundary is selected, data must be collected for all activities which occur in the boundary over a time frame of one calendar or financial year of production (neither choice is superior, but the chosen time frame must be transparently disclosed). It is generally expected that companies produce annual emission reports.

It is helpful to create a systemized process for data collection, management, and reporting. Data management may involve regular check-ins with leaders of various departments and automized systems for data collection. Established systems may be an eligible aspect of an environmental management system[3] ISO 14001. It is additionally recommended that personnel are provided with general energy and GHG awareness training to support accurate data collection.

2 WRI/WBCSD. Product Life Cycle Accounting and Reporting Standard. https://ghgprotocol.org/product-standard

3 ISO 14001:2015. https://www.iso.org/standard/60857.html.

HARMONIZED CARBON ACCOUNTING

This guidance proposes a harmonized approach to carbon accounting and reporting to facilitate both intra- and inter-industry collaboration within the copper production sector. The guidance can be used for both CCF and product-level CF. Corporate level carbon accounting encompass other businesses beyond copper mining and production, i.e., business travel, employee commuting, etc.

GHG inventory data collection should be based on a life cycle approach and aligned with the methodologies of the WRI/WBCSD' GHG protocol to the extent possible. Product-level carbon reporting should be grounded in ISO 14040 and 14044, while aligning with industry-specific guidance for multi-metal producers on allocation between co-products and the GHG Protocol to address other key industry-specific issues, such as land use change as it pertains to biogenic carbon emissions and waste/tailings management. For CCF, no allocation applies.

Consistency and comparability ensure that GHG data are usable, and the final outcomes are credible.

Consistency and comparability ensure that GHG data are usable, and the final outcomes are credible. As a result, harmonization is essential to fulfil both voluntary and required reporting guidelines.

In the following sections, key aspects (system boundary, data collection, activity data, etc.) for carbon accounting are described.

SYSTEM BOUNDARY

This guidance applies to all copper production routes, thus pyrometallurgical, hydrometallurgical and secondary routes are included in the scope. Mining and concentrate production as well as all related auxiliary processes, e.g., waste management, etc. are also included (**Figure 5** and **Table 3**). Activities that may be excluded from the scope of the product carbon footprint are listed in **Table 3**.

Copper is produced from a variety of primary and secondary raw materials. Raw materials contain significant and variable amounts of metals other than copper. Copper smelters process sulfidic copper concentrates consisting of complex copper/iron sulfidic minerals (15 - 45 % Cu) and other metal-containing minerals (Pb, As, Zn, Ni, Ag, Au, Pt, Pd, Se). Secondary raw materials include scrap and other complex materials with different contents of copper and other metals. Some producers process oxidic and complex oxidic/sulfidic ores using hydrometallurgical techniques.

The production processes are designed to produce copper. However, also other co-metal products such as lead, molybdenum (concentrate at mine level), tin and valuable metals e.g., silver, gold, platinum group metals, selenium and tellurium, are recovered as co-products during refining operations. Most operations also recover sulfuric acid and iron silicate.

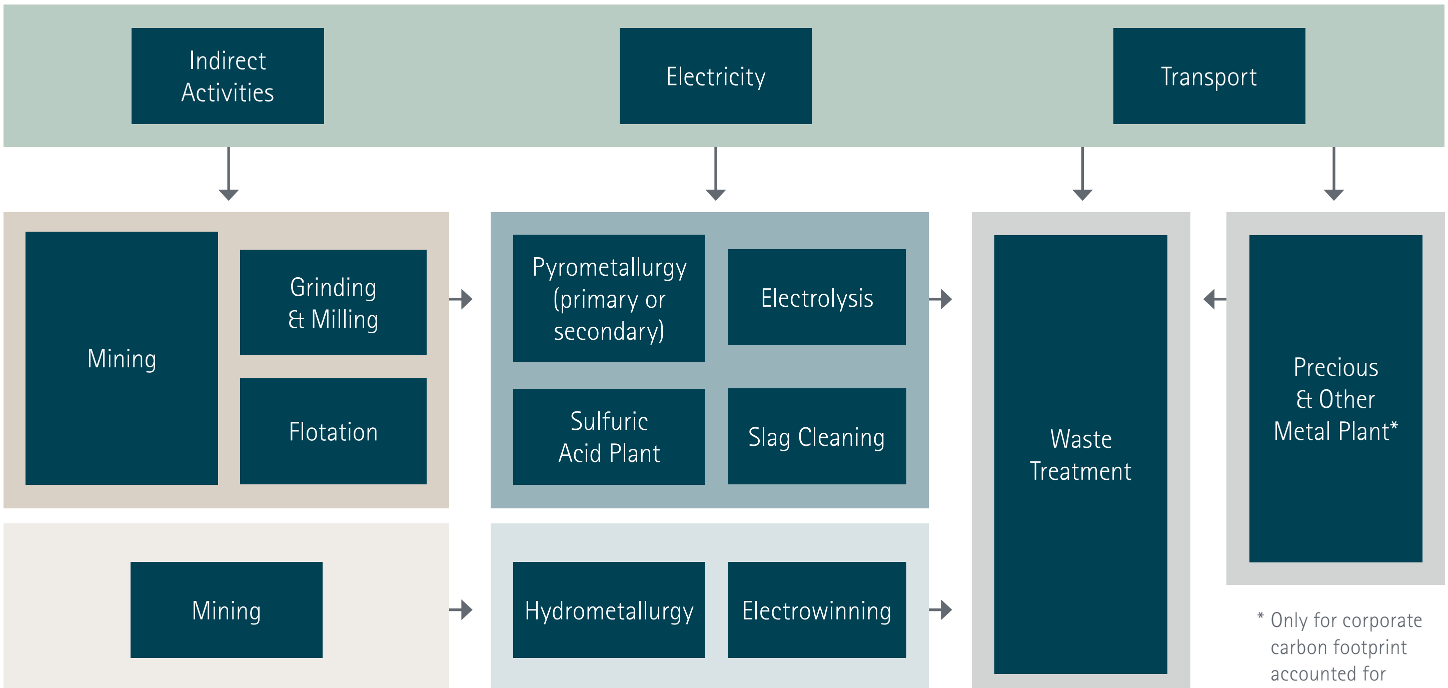

FIGURE 5: representatives processes of the copper production

INCLUDED	EXCLUDED	REASON FOR EXCLUSION
Mining of ore Beneficiation of ore to concentrate	Capital goods	Accounted for at corporate level
Production and upstream transport of ancillary materials and other feedstocks, i.e., scrap	Packaging materials Business travel	Accounted for at corporate level
Waste residues managed onsite	Employee commuting	Accounted for at corporate level
Wastewater treatment		
Effluents and emissions to air	Collection and pre-treatment of externally sourced secondary copper	Beyond the scope
Water usage		
Offsite waste disposal	Upstream and downstream Leased assets	Accounted for at corporate level
Internal transportation (e.g., transport from mine to smelter)	Downstream transport of sold products	Beyond the scope
On- and offsite electricity production	Processing of sold products	Beyond the scope
Overhead of manufacturing facilities	Use of copper products	Beyond the scope
Processing of materials and intermediates	Franchises	Beyond the scope
Energy production onsite and offsite	Investments	Beyond the scope
	End of life of copper products	Beyond the scope

TABLE 3: List of activities included or excluded from the scope of refined copper **product** carbon footprint.

Production system boundaries are defined to encompass all facilities and associated processes that are fully or partially owned and/or operated by the organization and that directly contribute to the provision of the product portfolio. The activities and impacts linked to processes within the defined production system boundaries are considered "direct" activities and impacts (see **Figure 5**).

Production system boundaries vary according to the product form and applicable production routes, and may include different routes as follows:

- Mining and beneficiation
- Primary copper pyrometallurgical route
- Secondary copper pyrometallurgical route
- Integrated pyrometallurgical multi-metal route
- Hydrometallurgical route

Different sub-modules may be combined depending on the route:

- Beneficiation and separation of different metal concentrate (copper, molybdenum, low grade, high grade, others)
- Primary smelting and converting (in two process steps or in one process step)
- Secondary smelting and converting
- Fire refining and copper electrolysis
- Recovery of Pb/Sn/zinc oxide
- Recovery of precious metals, crude selenium and/or tellurium, ammonium perrhenate
- Slag cleaning (and iron converting)
- Sulfuric acid plant products (Acid and liquid SO_2 and or oleum)
- Storage of raw materials
- Secondary material pre-treatment
- Leaching
- Solvent extraction
- Electrowinning
- All related auxiliary processes such as waste treatment (e.g., landfilling on site), wastewater treatment (on-site including for treatment of process water, direct cooling water and surface run off water), gas abatement systems (including for primary and secondary off gases), boilers (including pre-treatment of feed water), internal logistics, tailing management

Upstream processes:

- Production and supply (transport) of chemicals and auxiliaries
- Production and supply (transport) of fuels and other energy carriers (e.g., Steam)
- Production and supply of electricity
- Production of purchased anodes and blister copper (in case of gate-to-gate accounting e.g., only smelters)
- Transport of raw materials (copper concentrate, scrap, purchased anodes and blister) in vehicles not owned by the organization (in case of gate-to-gate accounting e.g., only smelters)
- Others

Downstream processes other than production waste and wastewater treatment are excluded from the system boundary. Transport of products included in the Product Portfolio to the next organization should not be included within the scope of this Guidance. End of life is excluded.

DATA COLLECTION

The following three steps define the practice of data collection for carbon accounting: drawing a system boundary, identifying activities that are emission sources, and measuring activities within the boundary over a certain time frame (in this case calendar or financial year of production). GHG activity data is then converted to quantities of CO_2eq.

To ensure completeness and validate the system under analysis each unit process should be subject to a material balance.

Site direct activities – Scope 1

The following requirements should be applied for collection of specific data:

- Primary/site-specific data should be collected specifically at/by the companies.
- The data should be collected in accordance with the applied technology and the relevant material and energy flows as well as relevant burdens of the processes. Information on technology used to produce the products (example type of furnace) as well as location of manufacturing site (country scale) should be provided in the report.
- The data should include all known GHG inputs and outputs for the core processes, including input of resources, primary metal/secondary metal, energy, water, fluxes, reagents and additives, outputs of products, co-products, intermediates disposal of waste/production residues, consideration of related emissions to air and water, and recycling of production scrap.
- The data collection should cover at least a calendar year (12 months) that is representative for the product portfolio produced.
- The following sources of data should be considered:
    - Process or plant level consumption data
    - Reports, invoices and stock/inventory-changes of materials, fuels, and consumables
    - Technical balance for metals in raw materials, final products, and intermediate products
    - Technical balance for water and steam distribution. The water balance should differentiate between type of input water per source (tap, river, lake etc.) and per use (process, cooling)
    - Emission reports to authorities as required by permits or to fulfil reporting requirements e.g., Pollutant Release and Transfer Register
    - GHG inventory calculations and reports under representative Emission Trading Scheme and international bodies (UN, International Energy Agency (IEA), IPCC)
    - Direct emission measurements (concentrations plus corresponding off-gas and wastewater amounts, based on highest standards of measurements as defined in reference documents (e.g., Best Available Techniques Reference Documents for the Non-Ferrous Metals Industries and other monitoring reference reports)
    - Reports on waste types and amounts and designated treatment (e.g. recycling, landfilling, ...)
    - Reports from procurement and sales departments (related to purchased auxiliary materials, explosives, concentrates, secondary raw materials, reagents, sold products)
- Information on the source of data (direct measurements, material balance, calculations using certain empirical formulas and factors, expert estimates) and methodology used for calculations should be provided in the report.

To ensure completeness and validate the system under analysis each unit process should be subject to a material balance. Using stoichiometric calculations, the mass of input flows should be compared with the mass of corresponding output flows. In practice, this means comparing the chemical ratios or the input material flows to the output material flows. The difference should be reported in percent for each unit process separately and the overall total difference should not exceed 10% (justification should be provided in case the 10% threshold is exceeded). If an aggregated approach is taken, then the mass balance should be reported on the aggregated system.

The calculations and measurements should follow existing standards or at least worldwide accepted guidelines (e.g., ISO, IEA and IPCC) and be mentioned in the report.

Fuel combustion

GHG emissions related to the combustion of fuels consumed may be calculated using the most recent default emission factors published by the IPCC.

If emission factors from other sources are used (e.g., local or national inventories), the justification should be mentioned in the summary report.

Electricity use

ICA recommends the following hierarchical approach in line with ISO 14067 for reporting electricity.

- Use of supplier-specific electricity mix/market based emission factor shall be used if available.
- For generated electricity on-site, the specific emission factor of the generation equipment shall be used based on the consumed fuel and renewables
- Fossil free share of electricity (Power Purchase Agreement (PPA)) should be accounted for in the CF calculation if traceable (e.g., by renewable energy certificates. The certificates should be documented in the report and available for the third-party reviewer to assess)
- The "country specific residual grid mix" should be used where available. Country-specific means the country in which the activity occurs. The residual grid mix prevents double counting with the use of supplier-specific electricity mixes
- The average country/region representative grid mix (consumption mix)/emission factor should be used

To reflect the complexity in accounting for emissions from electricity, ICA recommends dual reporting of emissions according to location and market-based approaches (as per the ICMM guidance mentioned above).

Steam use and/or generation

For purchased steam used as an energy carrier, supplier-specific factors should be used. If not available, default IEA-specific factors for the purchased region should be used; justification should be provided. In the case of self-generation of steam, the specific emission factor of the generation equipment will be used. If other emission factors are used, the justification should be mentioned in the report.

Transport

Transport within the defined system boundary (see also **Table 3**) is included.

Secondary data

Primary data for Scope 2 and 3 should be used whenever possible. Several auxiliary materials are used in copper production processes for which the copper producer might not be able to obtain primary data from suppliers or the relevant industry associations. These include lubricants, limestone, explosives, reduction agents or any other materials used in the production process. For those materials, reviewed and high-quality secondary data according to ISO 14044 data quality requirements or equivalent, should be used for at least 95% of the impact contribution to the final CF, which can commonly be found in free-of-charge and/or fee-based databases should be used. Emissions factors for Scope 3 upstream suppliers proposed by Alta Ley and ICMM as part of their work on mapping and harmonizing reporting of Scope 3 emissions should also be used, when available and relevant. The data used should represent the best proxy for the system under investigation with respect to the technological, geographical and time representativeness. The justification for the use of proxy data should be mentioned in the report.

ACTIVITY DATA

The activity data to be considered are listed for the main process steps of the copper production chain as follows:

Mining & benefication

- Explosives
- Diesel (for transport)
- Diesel (for electricity generation)
- Fuel (for electricity generation)
- Water
- CaO
- Sodium carbonate
- Steel balls
- Electricity
- Potassium amyl xanthate
- Sodium ethyl xanthate
- Sodium isopropyl xanthate
- Air

Slag cleaning by grinding & flotation treatment

- Thiocarbamat
- Na-isopropyl xanthate
- NH_4+Na dibutyl dithiophosphate
- Amyl xanthate
- Electricity
- Water

Electric slag cleaning

- Electrode (carbon)
- Electricity
- Fuel
- Coke

Slag fire-cleaning

- Coal
- Oil
- Natural gas
- Fuel

Primary smelting

- Flux
- Coke
- Oxygen
- Fuel (oil, coal, natural gas, hydrocarbon)
- Electricity
- Copper Concentrate (if supplied from third party)

Primary converting

- Flux (calcium carbonate, lime)
- Coke
- Oxygen
- Fuel (oil, coal, natural gas, hydrocarbon)
- Electricity

Fire refining

- Electricity
- Fuel (oil, coal, natural gas, hydrocarbon)
- Reducing agent (LPG, natural gas)
- Steam
- Water (direct cooling)
- Bliset (if supplied from third party)

Secondary smelting

- Oxygen
- Fuel (oil, coal, natural gas, hydrocarbon)
- Steam
- Electricity
- Electrodes (for eL furnace)
- Silica flux

Electrolysis

- Sulfuric acid
- Electricity
- Leveling agent
- Water
- Glue

Leaching & solvent extraction

- Sulfuric acid
- Electricity
- Diluent (alkyl+naphtenes+parafins)
- Extractant (LIX 984N is an aldoxime-ketoxime mixture)
- Water
- Calcium Carbonate

Electrowinning

- Sulfuric acid
- Electricity
- Guar gum
- Hydrochloric acid
- Water

Acid plant

- Water
- Electricity
- Catalyst (KV_2O_5)
- Steam
- Fuel (oil, coal, natural gas, hydrocarbon)

Precious metal winning

- Catalyst
- Borax flux
- Hydrochloric acid
- Chlorine gas
- Cyanide
- Hydrogen peroxide
- Sodium hypochlorite
- Acidic gold chloride
- Nitric acid
- Hydrochloric acid
- Ammonium
- Sodium chloride
- Potassium chloride
- Titanium (cathodes)
- Water
- Electricity

PROCESS STEP	DESCRIPTION	EMISSION SCOPE
Direct activities	Combustion emissions associated with fuels, reductants and other process emissions (air and water emissions)	Scope 1
Electricity onsite	Emissions associated with electricity generated on site	Scope 1
Electricity	Electricity from the national or local electric grid	Scope 2
Fuels, reductants	Production of fuels and reductants used in the process	Scope 3
Lubricants	Production of lubricants used in the process	Scope 3
Explosives	Production of explosives used in the process	Scope 3
Waste-water	Municipal waste-water treatment. The emissions associated with onsite water treatment fall under direct activities	Scope 3
Water	The upstream production of tap and process water	Scope 3
Transport	Includes the fuel for transport (the production thereof) and combustion of associated fuels	Scope 3
Credit	Impact associated with the credit of by-product assuming the conventional production route of respective by-product	Scope 3
Raw materials sourced from third parties	Copper containing primary and secondary raw materials	Scope 3
Auxiliary materials	Chemicals, reagents, additives	Scope 3

DATA QUALITY REQUIREMENTS

Data specification as follows shall apply:

- **Time representativeness:** The report shall indicate the reference year or the time period for which the data were collected and in concordance with the addressed physical year.
- **Technological representativeness:** The activity data shall reflect the technology used.
- **Geographical representativeness:** The data shall reflect the geography where the process takes place.
- **Data validity:** The activity date shall reflect the physical year to be addressed. Secondary data and background data shall reflect the technology and the geography of the system to be assessed.

ALLOCATION

For an organizational approach to CF calculation, no allocation of by-/co-products is applied.

In principle all products produced by the company in scope are part of the product portfolio. Products that may leave the system in the baseline scenario should be allocated considering their economic value and divided by the overall value generated by all the products in the product portfolio. Use of this allocation method must be determined for each company, depending on the real product portfolio produced by the company. Two companies will likely have two different product portfolios, therefore, the allocation factor for products exiting the system will be company specific. Companies must disclose their allocation methodology to ensure full transparency.

In the case of product specific CF calculation, allocation may be applied if many products are in the organization's portfolio. The applied methods should consider the type and properties of co-products being produced in line with ISO 14044, ISO 14067 and with the life cycle assessment practice for copper cathode (see ICA copper environmental profile). The proposed allocation methods to capture the multitude of co-/by-products from the copper system are summarized in **Table 4**. Any diverging allocation method should be disclosed.

PROCESS LEVEL	CO-PRODUCTS	TREATMENT METHOD
Mining	Sulfide ore	Mass of metal content
	Oxide ore	
Concentration	Copper concentrate	Mass of metal content
	Molybdenum concentrate and other concentrates	
Pyro- and hydrometallurgy processes	Steam	System expansion
	Lead/tin alloy/zinc oxide	Economic (10-year average)
Sulfuric acid plant	Sulfuric acid	System expansion
Electrolytic refining	Copper cathode (main product)	Economic (10-year average)
	Precious metals (via anodeslime): Ag, Au, PGM, $NiSO_4$ etc.	

TABLE 4: Allocation methods for co- and by-products

COMMUNICATION AND THIRD PARTY VERIFICATION

Transparent communication and interpretation of the results is of critical importance. This transparency and interpretation ensures trust and reliability in the output. Hence GHG emission calculations must display an overview of the methods and modeling parameters used and distribution of emissions from different scopes and credits. This is in line with the requirements of the International EPD system containing specific climate declarations based on ISO-14067. A list of products co-produced in addition to copper and covered by the calculated CF should be included.

Requirements laid out in the GHG Protocol Product Life Cycle Accounting and Reporting Standard should be followed when communicating of the copper GHG emissions to third parties. These include the principles of relevance, accuracy, completeness, consistency, and transparency.

Total GHG emissions should be reported by the producer of the product. In case a third party did the calculations, it should be stated in the report.

The report should inform on the cradle-to-gate GHG emissions of 1kg or 1 metric ton of copper and include:

- all relevant parameters chosen as listed in this guide
- the allocation method applied together with a justification and explanation
- the electricity modeling approach as outlined in section 5.
- the parameters used for fuel combustion
- a distinction of primary and secondary data used and their sources when relevant

Offsets are GHG reductions used to compensate for (i.e., offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap. In line with the GHG protocol, offsets should be used for an organizational footprint and should not be used to offset emissions accounted for in a product footprint. However, they may be reported separately. Similarly, avoided emissions, which are reductions in emissions that occur outside the reporting boundary as a result of company activities, should be reported separately from the product CF.

Transparent communication and interpretation of the results is of critical importance.

The CF calculated with this guidance is valid for up to 3 years and should be updated within this timeframe and the report should indicate the reference year for which the data was collected.

The reported data should be accompanied by a certificate conducted by an independent and external, qualified third party reviewer and verifier, confirming that the GHG data calculations were done according to these guidelines. Qualification refers to both expertise and experience in LCA and/or CF and to experience in the metals mining or metal production industry (including working in R&D organizations on metal mining, winning or refining processes, or also as consultant of LCA of metals if the work experience included working with primary data of the producing industry).

GLOSSARY AND DEFINITIONS

Activity: A practice or ensemble of practices that take place on a delineated area over a given period of time (IPCC glossary).

Activity data: Data of owned or controlled activity resulting in emissions taking place during a given period of time (adapted from IPCC glossary)

Allocation: Partitioning the input and/or output flows of processes to the product system under study (ISO).

Avoided emissions: Prevention of GHG emissions through change to existing process (i.e., new renewable energy project, improving energy efficiency, etc.)

Biogenic emissions: Methane emissions from land management practices and the oxidation and transformation or degradation of biomass.

Carbon footprint: A total product carbon footprint is a measure of the direct and indirect greenhouse gas (GHG) emissions associated with all activities in the product's life cycle. Products are both goods and services. Such a carbon footprint can be calculated by performing (according to international standards) an LCA that concentrates on GHG emissions that have an effect on climate change (UNEP/SETAC, 2009).

Corporate carbon footprint (CCF): is the total amount of greenhouse gases (GHGs) produced directly and indirectly by a company's activities.

End of life: The final stages of a product's existence.

Entity: Comprises a chain of processing steps within an organization of one or more unit processes that are logically grouped; may also be referred to as a "business unit". If there is more than one business unit within the company then each of those business units is described as an entity within the company.

Greenhouse gases (GHGs): Gases that have direct effects on climate change - carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3), etc.

Intensity metric/emission intensity: Calculated by dividing absolute emissions (the numerator) by an organization specific metric (the denominator).

Life cycle assessment (LCA): Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle. (ISO 2006).

Offsets: Purchased credits through verifiable sources which can be utilized to reduce total organizational carbon footprint. These must be transparently disclosed separate from the carbon footprint.

Primary data: Data determined by direct measurement, estimation or calculation at the producing company or its suppliers.

Product carbon footprint (PCF): is determining the climate impact of a product. Throughout the entire life cycle of a product climate-relevant impacts arise in the form of greenhouse gas emissions.

Product system: ISO defines product system as a collection of materially and energetically connected unit processes, which perform one or more defined functions. The term "product" used alone includes not only product systems but can also include service systems.

Scope 1: Direct emissions from owned or controlled sources.

Scope 2: Indirect emissions from the generation of purchased energy.

Scope 3: All indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.

Secondary data: Refers to data that is collected or owned by someone other than the primary user.

Site: Refers to the specific geographical locatino where a process step occurs.

Subdivision: Dividing the unit process into two or more unit processes that would be able to exist on their own.

System expansion: Isolating the burden associated with the product under study from those associated with co-products by subtracting the burden of the production of functionally equivalent products produced in a separate production route.

LITERATURE

1. GHG Protocol – Product Life Cycle Accounting and Reporting Standard (Product-Life-Cycle-Accounting-Reporting-Standard_041613.pdf (ghgprotocol.org))

2. Global Reporting Initiative, GRI (https://www.globalreporting.org/)

3. Organisation Environmental Footprint Sector Rules – Copper production (OEFSR_Copper.pdf (europa.eu))

4. Life Cycle initiative (About the Life Cycle Initiative - Life Cycle Initiative)

5. ISO 14067:2018, Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification

6. ISO 14044:2006, Environmental management — Life cycle assessment — Requirements and guidelines

7. Harmonization of LCA Methodologies for Metals (Harmonization of LCA Methodologies for Metals (euromines.org))

8. Copper environmental profile (https://internationalcopper.org/wp-content/uploads/2021/08/ICA-EnvironmentalProfileHESD-201803-FINAL-LOWRES-1.pdf)

9. IPCC report 2022 (AR6 Synthesis Report: Climate Change 2023 — IPCC)

10. United Nations for Climate Change (Microsoft Word - Global-Warming-Potential-Values.docx)

11. Non-CO_2 GHG (Microsoft Word - Chap12.doc (oecd.org))

12. EN 14626:2012, Ambient air - Standard method for the measurement of the concentration of carbon monoxide by non-dispersive infrared spectroscopy

13. EN 19694-2:2016, Stationary source emissions - Greenhouse Gas (GHG) emissions in energy-intensive industries - Part 2: Iron and steel industry

14. IEA Fuels & Technologies Conversion factors (Fuels & Technologies - IEA)

15. "Life Cycle Data Bases", GHG Protocol (https://ghgprotocol.org/life-cycle-databases)

16. A Harmonized Approach to Product Carbon Footprint and Life Cycle Assessment of Non-Ferrous Metals (ICMM, Unpublished)

ANNEX I

Publicly available "carbon intensity factors" of diverse substances and products*

Links:

Understanding Global Warming Potentials | US EPA

Microsoft Word - 2022-03_Global Warming Potential_GWP_AR4_AR5_Homepage_englisch (umweltbundesamt.de)

Microsoft Word - Chap12.doc (oecd.org)

eCFR :: 40 CFR Part 98 -- Mandatory Greenhouse Gas Reporting

* Please ensure that any factors used is representative for the system to be assessed.

International Copper Association

1600 International Drive
McLean, VA 22102

info@internationalcopper.org