

Securing Mining's Future

*Navigating uncertain markets
with expert data and analysis*

SKARN



PCF and LCA in Metals & Mining

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LCA and PCF are related, but they are designed for different primary jobs

Lifecycle assessment (LCA) and product carbon footprint (PCF) are sometimes discussed as if they were interchangeable. They are not. They share methodological foundations, but they are typically used for different purposes. ^[1-3]

LCA is the broader framework. It is designed to assess environmental impacts across a product system and is well suited to hot-spot identification, trade-off analysis, process improvement and wider sustainability strategy. That breadth is valuable in mining, where carbon, water, land disturbance, particulates and other impacts do not always move in the same direction. ^[1, 2, 9]

PCF is narrower by design. It applies lifecycle logic to a more focused question: the greenhouse gas emissions associated with a product. That narrower focus can make PCF more decision-useful where the question is specifically about carbon performance, product communication, customer dialogue or procurement. ^[3, 5]

PCF does not sit outside LCA. It sits within lifecycle logic. Both depend on choices around system boundaries, functional unit, allocation, data quality, background datasets and reporting assumptions. That means two studies can appear to assess the same product while producing results that are not directly comparable because the underlying design logic differs. Like LCA, PCF can be framed as cradle-to-gate, gate-to-gate or cradle-to-grave depending on the purpose of the study. ^[3, 6]

The distinction matters because different tools are useful for different jobs. LCA is strong where the objective is broader system understanding. PCF is stronger where the objective is carbon-specific communication.

Confusing the two can create noise, especially when the market begins asking comparison questions that neither a generic LCA nor a standalone PCF can answer on their own.

***PCF is often the first carbon language the market asks for.
LCA often provides broader analytical depth beneath it.
Neither automatically produces like-for-like comparison.***



LCA asks: what are the environmental impacts across the system?

PCF asks: what is the carbon footprint of this product?

***Both depend on boundaries, allocation,
data quality and assumptions.***

When the objective is comparison, methodology design choices matter

Valid studies are not necessarily directly comparable. Comparability depends on design choices and governance, not just calculation. ^[6, 8]

The challenge is not that LCA or PCF are weak. The challenge is that both allow methodological choices that can materially affect results. Those choices may be entirely valid within a given study design, but they can still make cross-entity comparison difficult. In metals and mining, treatment of co-products and complex process flowsheets are often the most material sources of divergence, which is why allocation and related design choices require explicit governance. ^[6]

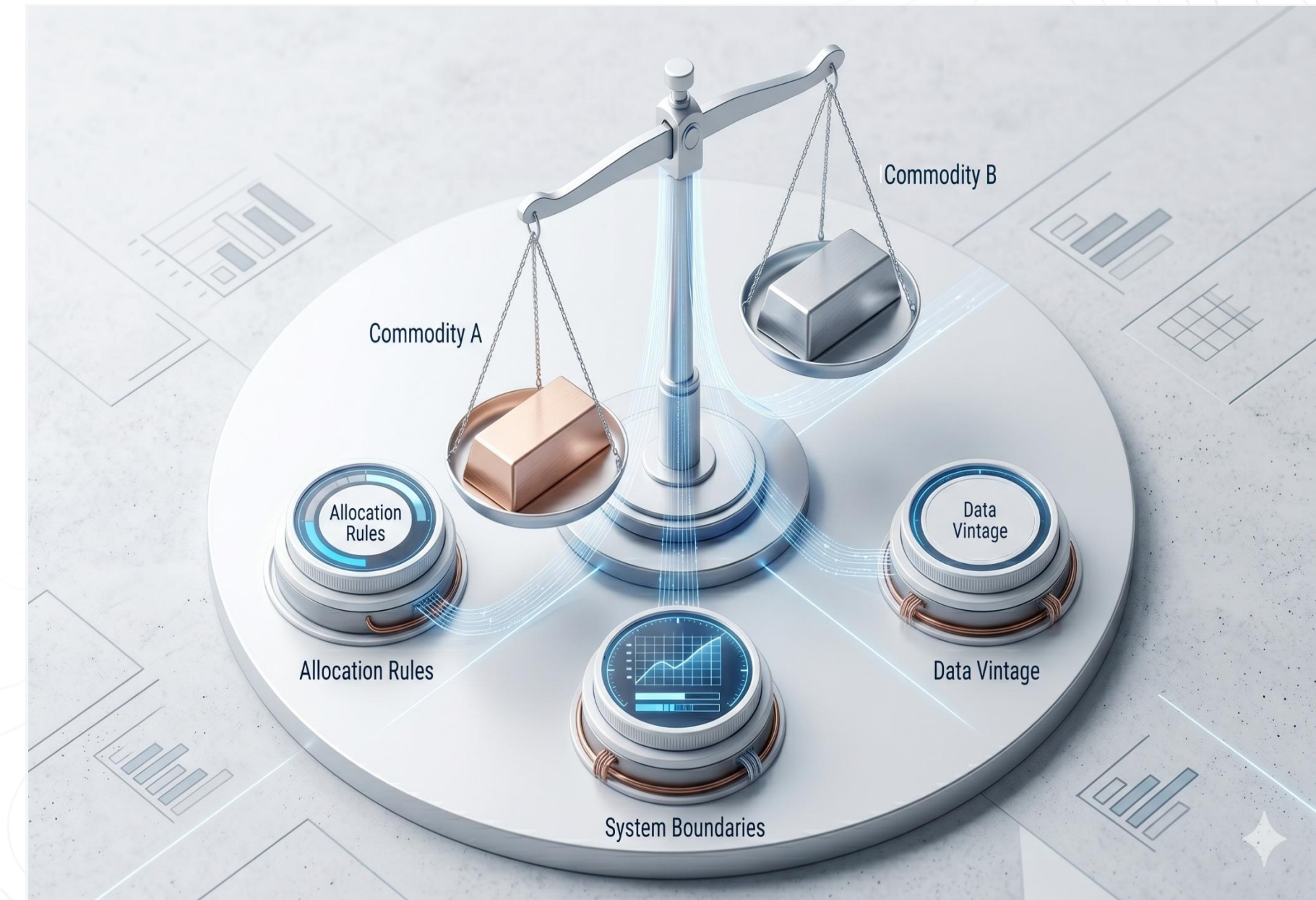
Results can move depending on system boundaries, allocation rules, treatment of recycling and co-products, electricity modelling, data vintage, geographical representativeness, reporting object and treatment of primary versus estimated data. This is why a study that is useful for internal analysis or customer communication is not automatically suitable as a market benchmark.

A practical way to think about this is to separate the jobs carbon data is being asked to do: ^[1-3, 6]

- If the objective is **internal hot-spot analysis, trade-off assessment or broader sustainability strategy, LCA is often the best fit.** If the objective is carbon communication, customer engagement or product-level carbon discussion, **PCF is often the more decision-useful format.**
- If the objective is **entity-to-entity comparison across assets, producers or value chains, rigorous harmonisation is needed.** At that point the issue is no longer only footprinting. It **requires a harmonised, benchmark-ready PCF framework** based on common rules and treatment.

Market participants are rarely asking for a methodological essay. They are usually asking a narrower question: **“What is the carbon intensity of this product, and how does it compare with confidence?”**

A lifecycle study is not the same thing as a market benchmark. Comparability must be designed in.



Where methodologies diverge: ^[5, 6, 8, 10]

- | | |
|---|--|
| • <i>system boundaries</i> | • <i>primary vs estimated data</i> |
| • <i>allocation rules</i> | • <i>intended application / audience</i> |
| • <i>recycling treatment</i> | • <i>product specification</i> |
| • <i>electricity modelling</i> | • <i>reference flow</i> |
| • <i>data vintage and quality</i> | • <i>data hierarchy</i> |
| • <i>reporting object / functional unit</i> | • <i>multifunctionality treatment</i> |

Implications for copper: from footprinting to credible comparability

Copper is emerging as a live test case for product-level carbon comparison because the commercial relevance of carbon claims is increasing faster than methodological alignment. Copper sits at the centre of electrification narratives and is **under growing scrutiny** in relation to product differentiation, procurement, contracting and potential future pricing mechanisms. ^[5, 7]

At the same time, **primary and secondary routes** are often discussed in simplified terms, even though treatment of allocation, recycling, processing route and system boundaries can materially affect results. This is where the **question of comparability** becomes more important. If the market wants to compare carbon performance across assets, producers, brands or value chains, additional design choices are required **beyond conducting a standalone LCA or PCF study**.

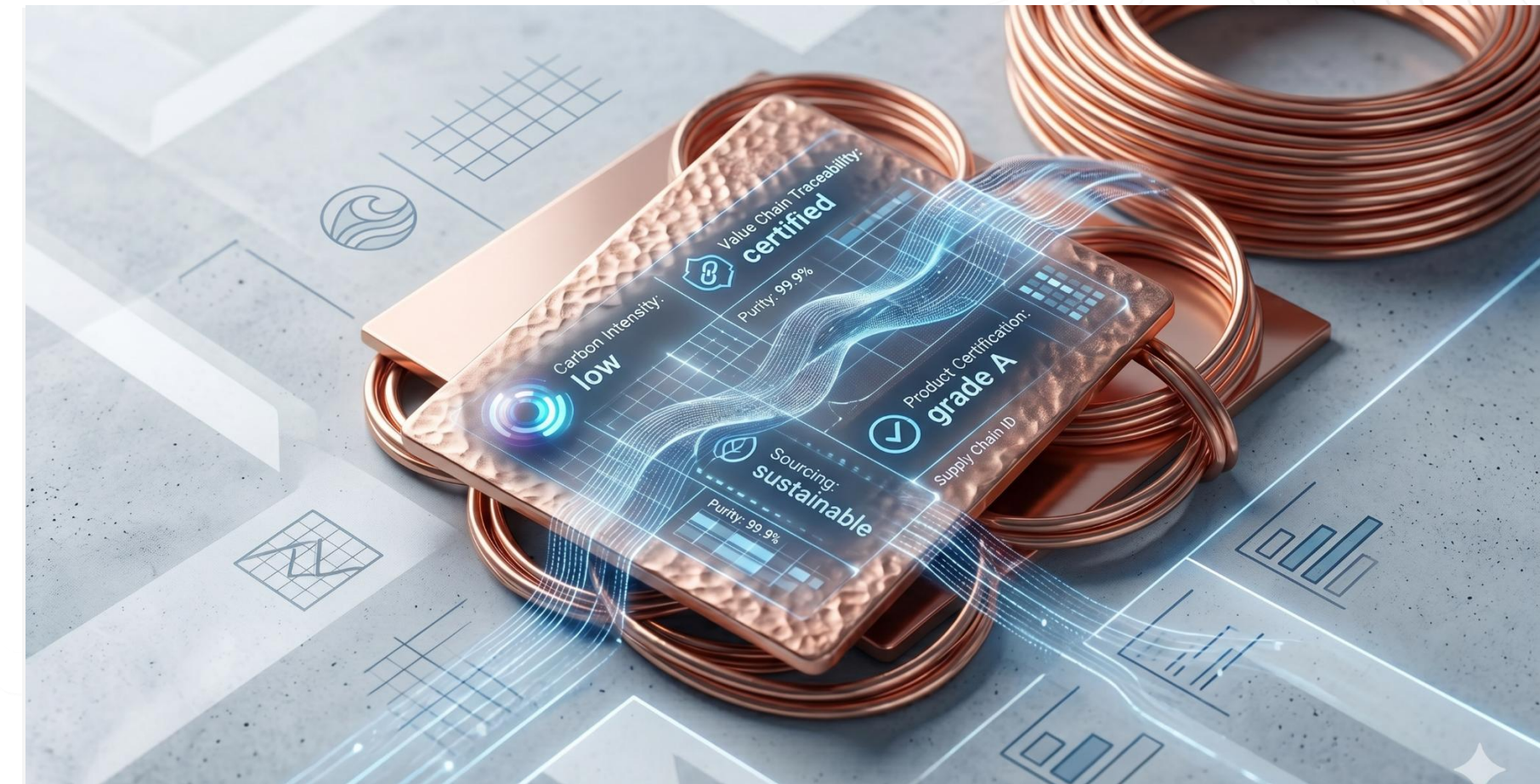
A more **benchmark-ready mechanism** would require common boundaries, common allocation logic, common treatment of data hierarchy, documented assumptions and a review process that can withstand challenge. In other words, if the objective is credible comparison, governance becomes as important as calculation. Where comparison claims are expected to influence market decisions, review and verification become part of the mechanism's credibility, not a postscript. ^[2-3, 5-7]

In practice, benchmark design is likely to rely on a combination of participant-submitted primary data and representative secondary background data, with comparability depending on clear rules for how each is used and disclosed. ^[4, 5, 8]

This does not mean LCA is obsolete, nor that a standalone PCF is fit for every purpose. It means that different tools serve different purposes, and that benchmark-ready comparability requires a more explicit level-playing-field approach. ^[6]

For stakeholders, the immediate question is not whether footprinting matters. It is what kind of carbon information is needed if the market wants comparison that is **credible enough to support real commercial use**.

***The next challenge is not more footprinting.
It is footprinting with comparability built in.***



What a benchmark mechanism would require

- common system boundaries
- common functional unit / reporting object
- common allocation logic for co-products and recycling
- explicit data hierarchy for primary and secondary inputs
- documented assumptions and traceability
- sensitivity testing for material design choices
- transparent review / verification and governance

Why copper is a live test case

- Growing scrutiny of primary vs secondary routes
- Increasing relevance in procurement, contracting and differentiation
- Rising need for a level playing field in carbon comparison

- [1] ISO 14040:2006 - Environmental management - Life cycle assessment - Principles and framework
- [2] ISO 14044:2006 - Environmental management - Life cycle assessment - Requirements and guidelines
- [3] ISO 14067:2018 - Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification
- [4] ISO 14071:2024 - Life cycle assessment - Critical review processes and reviewer competencies
- [5] International Copper Association (2022) - Carbon Footprint of Copper Production: Best Practice Guidance for Greenhouse Gas Measurements
- [6] Berger, M. et al. (2026) - Harmonized calculations methods for product carbon footprints and life cycle assessments in the mining and metals industry
- [7] Ekman Nilsson, A. et al. (2017) - A Review of the Carbon Footprint of Cu and Zn Production from Primary and Secondary Sources
- [8] Rihner, M.C.S. et al. (2025) - Life cycle assessment in energy-intensive industries: Cement, steel, glass, plastic
- [9] European Commission, DG Environment (2021) - Commission Recommendation on the use of the Environmental Footprint methods
- [10] GHG Protocol (2011) - Product Life Cycle Accounting and Reporting Standard