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TraceMet - Calculation and Reporting Rules

Traceability – a pilot for sustainable metals and minerals (TraceMet)

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In cooperation with Boliden, Elektrokoppar, ABB, LKAB, SSAB, Volvo Group and Scania

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PREFACE

This document was compiled during 2020 and early 2021 within the TraceMet project, funded by the strategic innovation program Swedish Mining Innovation, a joint investment of Vinnova, Formas and the Swedish Energy Agency. The document contains the Product Category Rules (PCR) - the methodology rules for how to calculate and report carbon footprint and recycled content for metal products.

The document contains the *Product Category Rules (PCR)* - the methodology rules for how to calculate and report carbon footprint and recycled content for metal products and *Specific Methods, Assumptions and Data (SMAD)* for the two pilots with specific metal qualities.

Project management

The project was managed by IVL Swedish Environmental Research Institute.

Participating companies

The following companies participated and contributed as pilots:

Copper value chain

- Boliden
- Elektrokoppar
- ABB

Steel value chain

- LKAB
- SSAB
- Volvo Group
- Scania

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1 Product Category Rules (PCR)

1.1 INTRODUCTION

The value chain for producing a metal product generally (but not necessarily) consists of several different metal producing companies. The producing companies participating in this project were Boliden and Elektrokoppar for the copper value chain and LKAB and SSAB for the steel value chain. The companies purchasing the metal products for manufacturing of complex products were ABB for the copper chain and Volvo Group and Scania respectively for the steel chain.

The companies shall report carbon footprint and degree of recycled metal (recycled content) to the block-chain for the Chain of Custody (CoC).

This Product Category Rules (PCR) document regards how the companies shall calculate and report these two measures. The PCR has been developed by IVL and the rules are based on several standards and similar documents, such as:

- General program instructions (GPI) for the International EPD® system (GPI 2019).
- PCR (in two versions) for construction products within the International EPD® system (PCR 2012:01 and PCR 2019:14).
- ISO standards for Environmental labels and declarations (14025:2006)), for Lifecycle assessment (14040:2006 and 14044:2006) and for Carbon footprint (ISO 14067:2018).
- General method for assessing the proportion of recycled material content in energy-related products (SS-EN 45557:2020)
- Sustainability of construction works- Environmental product declarations – Core rules for the product category of construction products (EN 15804:2012+A2:2019).

For pilot-specific detailed rules the document *Specific Methodology, Assumptions and Data (SMAD)* applies, which are line with this PCR. There is one SMAD for copper wire rod and one for hot rolled steel.

1.1.1 DEFINITIONS AND ABBREVIATIONS

Definitions

The reporting company: "**core CoC company**".

The product that is purchased by the end customer in the CoC: **"final CoC metal product"**

The product that is sold by the core CoC company: **"core CoC metal product"**

The main metal in the metal product in the Chain of custody:" **core CoC metal"**

Other pure core metals, e.g. recycled pure core metal: **"core metal"**

The main 100% *primary* metal that may be in a metal product in the Chain of Custody: **"core CoC primary metal"**

Carbon Footprint (CF): Greenhouse gas emissions for a product calculated according to ISO 14067 and this PCR.

Abbreviations

Abbreviations	
CoC	Chain of Custody
CO_2 e or CO_2 eq	CO_2 equivalents
CF	Carbon Footprint
EPD	Environmental Product Declaration
LCA	Life Cycle Assessment
PCR	Product Category Rules
SMAD	Specific Methodology, Assumptions and Data. There is one SMAD for each final CoC metal product.

1.1.2 VALIDITY OF THIS PCR

This PCR is valid only for this pilot project, but the idea is that the PCR could be applicable for any steel or copper product for which reporting of carbon footprint and recycled content is to be done in a CoC and reporting to a block-chain. Thus, it is a demonstration of the possibility for how a PCR could look like in this area of application. For the Chain of Custody, also the rules in the supplementary SMAD for each final CoC metal product respectively shall be followed.

These PCR rules apply for internal use within and between the CoC companies. For public communication, additional reporting according to the requirements in ISO 14067 is required.

1.2 METHODOLOGY RULES

1.2.1 SYSTEMS’ APPROACH

The systems’ approach of the International EPD® System including Module D in the EN 15804 standard has been applied i.e. attributional (bookkeeping) LCA with some consequential LCA (similar to but not same as the EU Product Environmental Footprint (EU PEF) approach), meaning that it is a hybrid approach with mainly bookkeeping LCA and some consequential LCA. The following applies and is based on the bookkeeping approach:

- specific or average data shall be used (i.e. not marginal data), and
- allocation issues may be solved via allocation rules. Allocation is the preferred method. Which method (allocation or system expansion) to use is clarified in chapter 2.4.

The purpose of using this approach is to make information traceable, documented, and possible to verify.

The consequential approach is applied for the so called “carbon resource management”, which considers the net GWP impact over the entire life cycle.

1.2.2 DECLARED UNIT

The declared unit provides a reference by means of which the material flows of the information module of a product are normalised (in a mathematical sense) to produce data, expressed on a common basis.

The declared unit in the block-chain module is 1 tonne of final CoC metal product.

For all companies in the block-chain they report data for their core CoC metal product. The block-chain system normalizes the data to its contribution to *1 tonne of final CoC metal product*.

1.2.3 SYSTEM BOUNDARIES

1.2.3.1 GENERAL

The system boundaries should be from "cradle-to-gate", where the cradle represents extraction of natural resources for the production of all raw materials and energy carriers required for the production of the metal product. The system boundaries however depend on which companies reports to the CoC. For example, if the supplier of iron ore pellets takes part in the CoC, the steel producer shall report "cradle-to-gate" but excluding the iron ore pellets production.

The gate represents the factory gate of the producer of the metal product. The LCA calculation procedures shall be done in a way so that it is possible to present the environmental results separated into the following life cycle stages:

- Core processes (scope 1) (from gate-to-gate);
  The core processes are represented by the site(s) of the core company's part of the CoC and should contain the environmental impact from the combustion of fuels used at the core site(s) as well as from other potential site-specific emissions (if relevant) e.g. carbon dioxide arising from combustion of carbon in raw materials. The core life cycle stage also includes internal transportation.
- Upstream processes (from cradle-to-gate, scope 2 and 3);
  Should include the environmental impact associated with the production and transportation of materials and energy carriers required for the production of the metal product excluding production processes of companies that take part in the CoC and their raw material and energy use, because they report separately to the CoC. It is not required to separately present scope 2 (production of electricity used in the core process) and scope 3 (the other upstream processes described above).
- Carbon resource management (from cradle-to-grave);
  This measure is optional in the TraceMet methodology and is a broader carbon footprint measure, which considers the net GWP impact over the entire life cycle, see section 1.3.2.4.

The life cycle stages described above are illustrated in Figure 1.1.

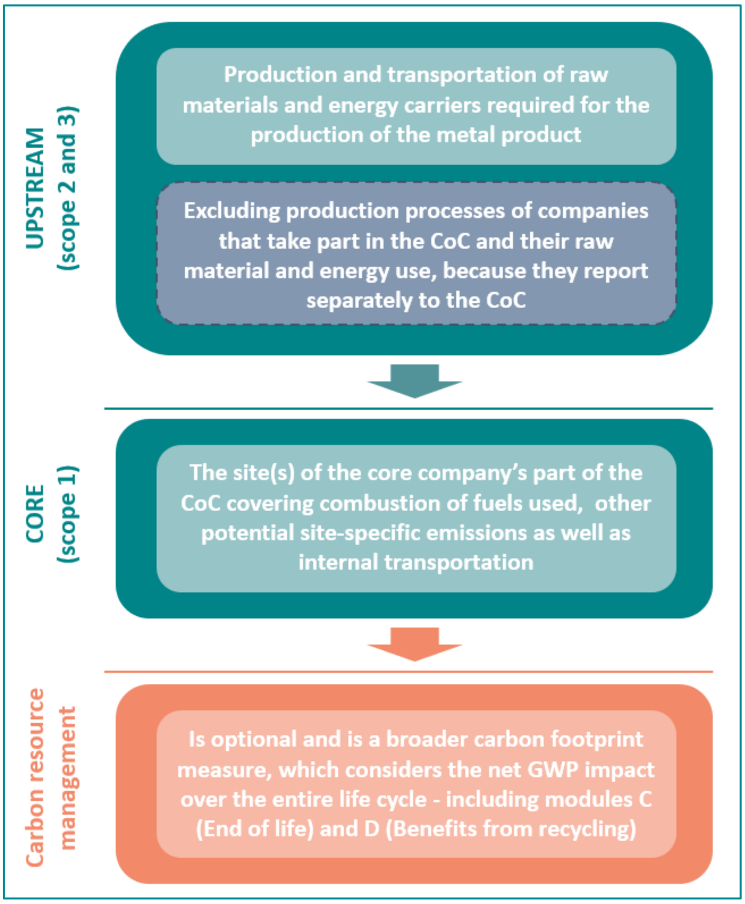


Figure 1.1: Life cycle stages for presentation of environmental results.

1.2.3.2 CORE PROCESSES

The following processes/life cycle stages shall be included if they are part of the activities of the core company (scope 1):

Mining, metal pellets production, metal product production, fabrication and manufacturing.

Inclusion of other processes/life cycle stages for all core processes as defined above

- Internal transportation.
- In case that the core process incorporates (at the same site) processing of any purchased recycled material and the transport from the recycling process to where the material is used.
- Packaging materials etc. used (if relevant).
- Production of ancillary materials or pre-products.
- Treatment of waste generated from the manufacturing processes. Processing up to the end-of-waste state or disposal of final residues including any packaging not leaving the factory gate with the product.

1.2.3.3 UPSTREAM PROCESSES

The following upstream (scope 2 and 3) processes/life cycle stages are included:

- Extraction and processing of raw materials.
- Recycling processes of secondary materials from a previous product system which are not part of the Chain of Custody, but not including those processes that are part of the waste processing in the previous product system, referring to the polluter pays principle. These upstream processes belong to scope 3.
- Generation of electricity, steam and heat (scope 2) from primary energy resources, also including their extraction, refining and transport. This includes energy needed for raw material supply and energy for manufacturing in the core process.
- Energy recovery and other recovery processes from secondary fuels, but not including those processes that are part of waste processing in the previous product system.

1.2.3.4 GEOGRAPHICAL BOUNDARIES

The data for the core module shall be representative for the actual production processes and representative for the site/region where the respective process is taking place.

The data for the upstream module shall be as representative as possible for the actual market.

1.2.3.5 TIME BOUNDARIES

For core processes

Data to the CoC are reported on annual basis based on the year before the reporting.

Measurements during the year should be as often as needed for a stable yearly average value calculation.

For upstream processes

Data sets used for calculations shall have been updated within 10 years for generic data and within 5 years for supplier specific data.

1.2.3.6 BOUNDARIES TO NATURE

System boundaries to and from nature are jointly described by so-called elementary flows. The inclusion of resource flows from nature to the technosphere corresponds to resource use and explorative impact, and on the output side emissions and resource consumption.

Waste to landfills is modelled to achieve elementary flows in a 100-year time perspective.

1.2.3.7 MANUFACTURING OF EQUIPMENT AND EMPLOYEES

The following system boundaries are applied on manufacturing equipment and employees:

- Environmental impact from infrastructure, construction, production equipment, and tools that are not directly consumed in the production process are not accounted for in the LCI.
- Personnel-related impacts, such as transportation to and from work, are also not accounted for in the LCI.

1.2.3.8 BOUNDARIES TO OTHER PRODUCT LIFE CYCLES

The **polluter-pays principle** approach without system expansion for the **end-of-life** of the core CoC metal product

This approach is mandatory. If needed, system expansion is allowed as a complement, see the next sub-section.

Allocation of recycled material, also known as open loop recycling, is reported in the inventory as an input or output technosphere flow when such materials leave or enter the specific product system. Therefore, a system boundary between the product's systems in a material recycling cascade has to be defined between individual sub-processes.

When a product is discarded and its original function is lost, it can be processed further in a waste management system. Those parts of the initial product system that are utilised in a new product will be accounted for as material recycling in the LCI (as a flow to technosphere). The secondary user of recycled material will account for the use of recycled material (as a flow from technosphere).

The boundary to the next product cycle is defined as when the product reaches its lowest value, thus the exact boundary settings between the first and the next product systems are defined by the willingness to pay for the recycled material. This implies that from the moment the user of a secondary material pays for the material, this (secondary) product system will also be responsible for the environmental burden from that point on. This principle is in the International EPD® System referred to as the Polluter Pays (PP) allocation method.

Consequently, if there is an inflow of recycled material to the production system, the recycling process and the transportation from the recycling process to where the material is used shall be included. If there is an outflow of material to recycling, the transportation of the material to a sorting facility/recycling process shall be included. The material intended for recycling is then an outflow from the production system.

Inclusion of **system expansion** for the **end-of-life** of the core CoC metal product carbon resource management

System expansion means that the product system is expanded to include the benefits from e.g. recycling of a material after use in a product. The benefits are obtained by providing a credit for the alternative production of the material i.e. by subtracting the alternative production from the product system.

In EPDs, system expansion is generally not allowed. In the EN15804 standard, on which PCRs for building product EPDs are based, the so called "module D" is mandatory. Module D reflects the benefits from recycling of the material(s) after use in a product by applying credits (i.e. system expansion). It is however not allowed to add module D obtaining one single score.

In the TraceMet PCR, and as a complement to the polluter-pays principle, it is allowed to report the carbon footprint based on system expansion for the core CoC metal product in case it is recycled after use in a product. This is done by providing a credit for the avoided production of the metal. This is in the TraceMet methodology called "carbon resource management carbon footprint" (see section 3.2.4). The data and calculations applied shall be reported in the SMAD document.

1.2.4 ALLOCATION RULES

1.2.4.1 General

Below the general rules for allocation are described. They regard both what is produced in the core process but also what is received from upstream processes. It is mandatory to document and clearly motivate the allocations and system expansions. This shall be reported in the SMAD document.

In a process step where more than one type of product is generated, it is necessary to allocate the environmental inputs and outputs to and from the process, to the different products (functional outputs) in order to get product-based inventory data instead of process-based data. An allocation problem also occurs for multi-input processes.

In an allocation procedure, the sum of the allocated inputs and outputs to the products shall be equal to the unallocated inputs and outputs of the unit process.

The following stepwise procedure shall be applied for co-product allocation processes:

1. Allocation shall be avoided, if possible, by dividing the unit process into two or more sub-processes and collecting the environmental data related to these sub-processes. A sub-process system's boundary appears:
   a. each time a product is generated and leaves the specific analysed product system,
   b. each time a waste flow appears and leaves the specific analysed product system,
   c. when product flows are treated in various ways in a process, or
   d. when a material recycling loop occurs outside the own process step.
2. Allocation shall be based on physical properties (e.g. mass, volume) when the difference in revenue from the co-products is low. An allocation can now be performed for each sub-system where the inputs and outputs of the system shall be partitioned between its different products or functions in a way that reflects the underlying physical relationships between them; i.e. they should reflect the way in which the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system..
3. In all other cases, including joint co-production processes, where no relevant underlying physical relationships between the products and co-products can be identified, the inventory of the remaining parts of process should be allocated between the products and co-products in a way that reflects the economic value of the co-products when they leave the unit process. The economic value of the co-products may be assessed by considering the proportion of revenue generated by each coproduct. The revenue is the price multiplied by the output. For both price and output, representative values should be identified (e.g. rolling annual averages).

   Any specifications of the rules shall be documented in the SMAD document.

   If neither of the methods above is appropriate, it is allowed to have a conservative approach, thus to allocate all CO_2eq emissions to the main product. This shall be documented in the SMAD document.

1.2.4.2 Inclusion of system expansion in the production of the core CoC metal

It is allowed to apply system expansion, also called open-loop allocation, giving credit to avoiding other typically production impacts for a by-product.

1.2.5 CUT-OFF RULES

Life Cycle Inventory data for a minimum of 99% of all material and energy flows to a single unit process and 95% of the total inflows (mass and energy) to the upstream and core module shall be included. Inflows not included in the LCA shall be documented. Data gap with an assumed potential importance in the included modules shall be reported including an evaluation of its significance.

1.2.6 DATA QUALITY RULES

1.2.6.1 SPECIFIC DATA

Site specific data gathered from the sites where specific processes are carried out, shall be used for the core module by the core company (scope 1). The requirement for site specific data also includes actual product weights, amounts of raw materials used and amounts of waste, etc.

If a company reports their carbon footprint (scope 1 emissions) to the EU-ETS system, these data should if possible be used in the calculations. Data shall be sourced from the companies' material logistics and the financial systems and compared so that the actual amounts of raw materials are verified to the highest possible extent without using new types of collecting data. Further details about the scope 1 carbon footprint can be found in the SMAD document.

For the electricity used in the process, there are two alternatives: the company buys the energy from the electricity mix on the actual market or from a specific supplier. While in the first case the national electricity mix shall be adopted, in the second case a specific energy mix could be used if available. Electricity production impacts shall be accounted for in this priority:

- Renewable Energy Certificates (RECs) or Guarantee of origin from supplier
- Electricity supplier's residual energy mix
- National mix/electricity mix on the actual market (preferably residual mix), otherwise national mix

1.2.6.2 RULES FOR GENERIC DATA

For allowing the use of selected generic data (mainly used for scope 2 and 3), a number of pre-set characteristics shall be fulfilled and demonstrated:

- Representativeness of the geographical area should adhere to "Data deriving from areas with the same legislative framework and the same energy mix,"
- Technological equivalence adhere to "Data deriving from the same chemical and physical processes or at least the same technology coverage (nature of the technology mix, e.g. weighted average of the actual process mix, best available technology or worst operating unit),"
- Boundaries towards nature adhere to "Data shall report all the quantitative information (resources, solid, liquid, gaseous emissions; etc.) necessary," and
- Boundaries towards technical systems adhere to "The boundaries of the considered life cycle stage shall be equivalent."

1.2.6.3 SELECTION OF DATA

Upstream data not from companies in the CoC, shall be as current as possible. Data sets used for calculations shall have been updated within 10 years for generic data and within 5 years for supplier specific data. Data sets shall be based on 1-year averaged data; deviations shall be justified.

Site specific data for at least the processes the producer of the specific product has influence over shall be applied. Generic data may be used for the processes the producer cannot influence e.g. processes dealing with the production of input commodities, e.g. raw material extraction or electricity generation often referred to as upstream data.

Upstream core primary metal that is not part of the Chain of Custody shall not be included in the block-chain. In those cases, mass-balance calculations may have to be carried out by the core CoC company in order to be able to report data for their core CoC metal product. The methodology for the calculations is to be reported in the SMAD document.

1.2.6.4 POTENTIAL CLIMATE CHANGE IMPACT, CARBON FOOTPRINT

One environmental impact category shall be reported according to the TraceMet methodology and that is global warming potential (GWP) or climate change) [kg CO_2 equivalents (GWP_{100})] and is in TraceMet called *carbon footprint*.

The climate change method according to the EN15804+A2 standard (CEN (2019)) shall be applied in the TraceMet methodology (Table 1.1).

Table 1.1: Examples of the most important GWP factors according to the EN15804+A2 standard (CEN (2019).

Parameter (1)	EN15804+A2 GWP (total) (2)
CO_2, fossil	1.0
CO_2, bio	1.0
CO_2, renewable resource	1.0
CH_4, fossil	36.8
CH_4, bio	36.8
N_2O	298.0

(1) CO_2 = Carbon dioxide, bio means biogenic, CH_4 = Methane, N_2O = Nitrous oxide or dinitrogen oxide (laughing gas).

(2) In the EN15804 standard GWP is divided into total, biogenic and fossil. The characterisation factors were extracted from the Gabi LCA software (Quantity in Gabi called "EN15804+A2 Climate Change"). They are based on EF3.0, but also include Carbon uptake and release, which EF3.0 doesn't.

1.3 DEFINITIONS OF RECYCLED CONTENT AND CARBON FOOTPRINT

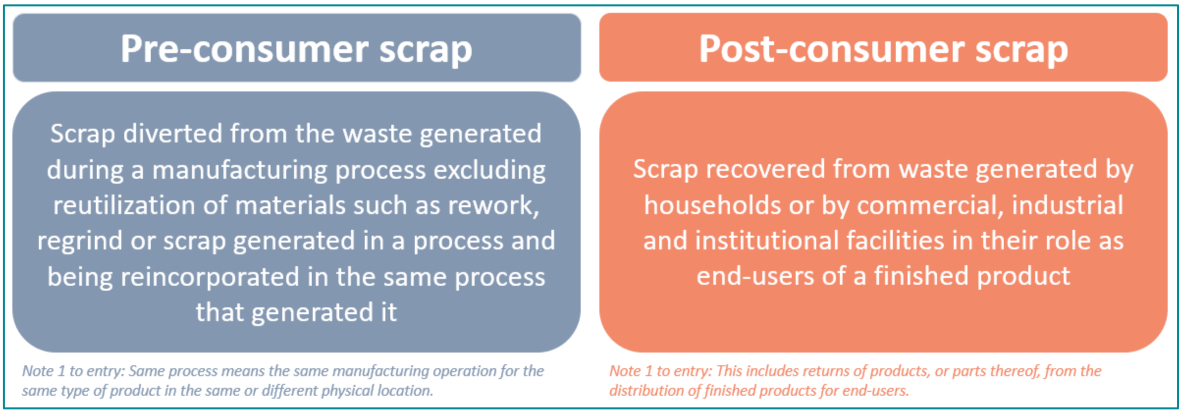
1.3.1 RECYCLED CONTENT

The TraceMet methodology allows for reporting two measures for recycled content:

- Pre- and post-consumer recycled content (%)
- Post-consumer recycled content (%)

1.3.1.1 DEFINITIONS OF PRE- AND POST-CONSUMER SCRAP

The definition in the SS-EN 45557:2020 is applied in the TraceMet methodology (Figure 1.2).



Pre-consumer scrap

Scrap diverted from the waste generated during a manufacturing process excluding reutilization of materials such as rework, regrind or scrap generated in a process and being reincorporated in the same process that generated it

Note 1 to entry: Same process means the same manufacturing operation for the same type of product in the same or different physical location.

Post-consumer scrap

Scrap recovered from waste generated by households or by commercial, industrial and institutional facilities in their role as end-users of a finished product

Note 1 to entry: This includes returns of products, or parts thereof, from the distribution of finished products for end-users.

Figure 1.2: Definition of pre- and post-consumer scrap in the TraceMet methodology.

The EN 45557 standard in turn refers to the ISO 14025:2006 standard.

1.3.1.2 DEFINITIONS OF RECYCLED CONTENT

The definitions of the two measures for recycled content are illustrated in Figure 1.3.

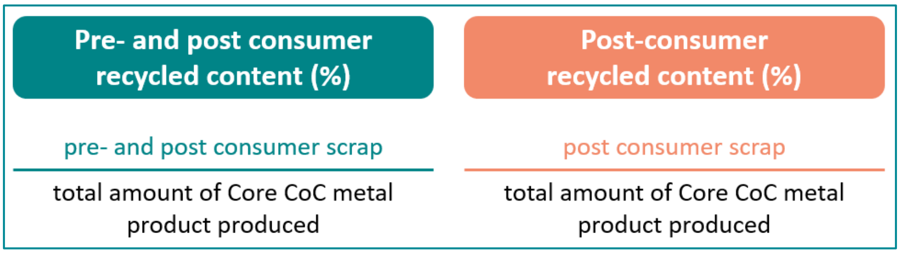


Figure 1.3: Definition of pre- and post-consumer recycled content as well as post-consumer recycled content in the TraceMet methodology.

Post-consumer recycled content is mandatory while pre- and post-consumer recycled content is optional.

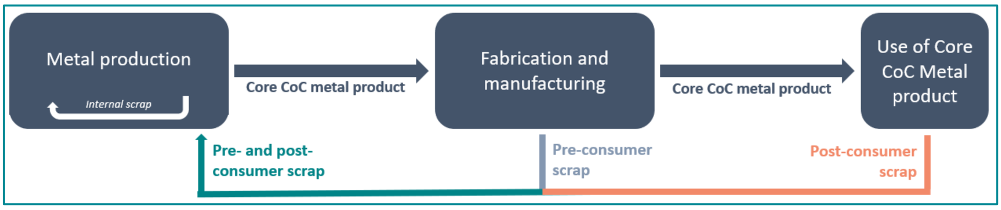


Figure 1.4: General illustration of the recycled content definition in the TraceMet methodology.

Example

For steel produced via the blast furnace route, the TraceMet methodology defines the pre-consumer scrap as scrap generated in processes downstream the steel works e.g. in the hot rolling, cold rolling and coating processes as well as manufacturing downstream in the value chain. Scrap generated in the blast furnace or in the basic oxygen furnace is not defined as pre-consumer scrap but considered as internal scrap (see internal scrap in the metal production in the figure).

1.3.2 Carbon footprint

This measure reflects the carbon footprint for the metal product and covers all steps of the value chain from cradle to gate and in one case also from cradle to grave (see Carbon resource management, section 1.3.2.4). Calculations shall be done according to ISO 14067 (2018).

Example

For steel, the cradle to gate carbon footprint for the iron pellets production is compiled by the iron pellets producer and the cradle to gate carbon footprint for the steel production (but excluding the iron pellets production) is compiled by the steel producer. The total carbon footprint is calculated by adding the cradle to gate carbon footprint from the iron pellets and from the steel production.

There are four options for the carbon footprint measure. It is allowed to choose one or more options and the selected measure shall be reported in SMAD, but it is however not allowed to choose only the carbon resource management carbon footprint;

- Carbon footprint for the final core CoC metal product or core CoC metal product
- Carbon footprint for the core CoC primary metal or metal product
- Carbon footprint for the core recycled metal or metal product
- TraceMet steel specific: Carbon resource management carbon footprint

1.3.2.1 Carbon footprint for the FINAL core CoC metal product

This measure is mandatory in the TraceMet methodology and is the carbon footprint measure based on the value chain for the actual production.

1.3.2.2 Carbon footprint for the core CoC primary metal or primary metal product

This measure is optional in the TraceMet methodology and is a carbon footprint measure compiled based on if the metal is entirely produced from primary metal source.

1.3.2.3 Carbon footprint for the core recycled metal or recycled metal product

This measure is optional in the TraceMet methodology and is a carbon footprint measure compiled based on if the metal is entirely produced from secondary (recycled) metal source.

1.3.2.4 Carbon resource management carbon footprint

This measure is optional in the TraceMet methodology and is a broader carbon footprint measure, the so called "Carbon resource management", which considers the net GWP impact over the entire life cycle (Figure 1.5).

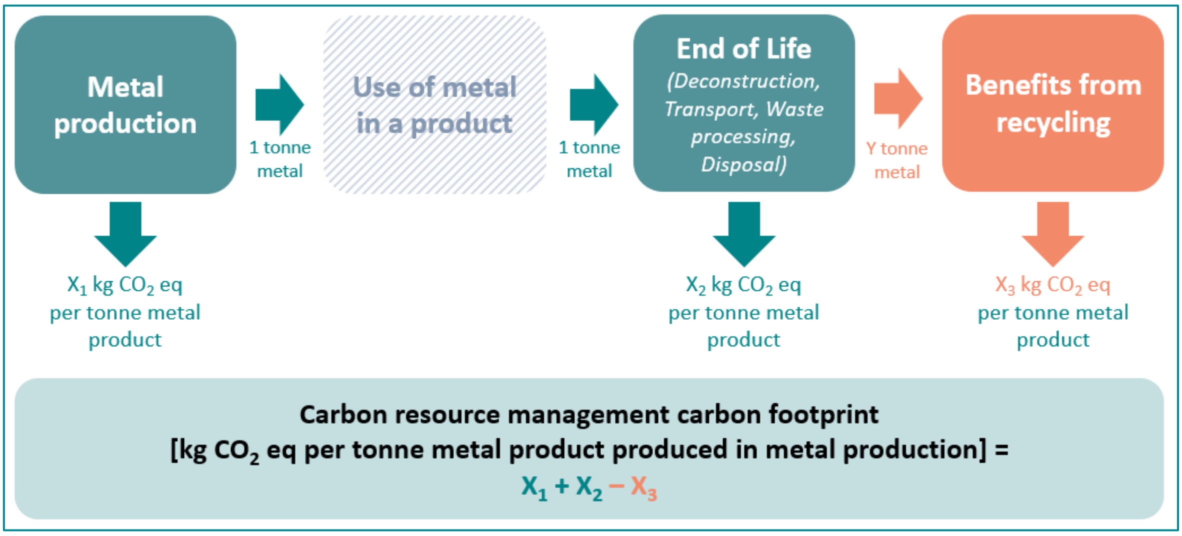


Figure 1.5: Definition of carbon resource management carbon footprint considering the net GWP impact over the entire life cycle in the TraceMet methodology.

The calculations for the end of life and the benefits from recycling shall be in line with the EN15804 standard - the so-called module C (end of life) and module D (benefits from recycling).

The carbon footprint from the metal production (X_1) is the measure calculated under carbon footprint for the pure core CoC primary metal above. The use of the metal product is not considered in the calculation. The end of life activities such as deconstruction (X_2) of a hypothetical (representative) product, involved transportation, waste processing and disposal of the metal not being recycled have to be covered. The benefits from recycling (X_3) of the remaining metal (Y tonne per tonne metal product) is calculated by providing an environmental credit. For steel, this is done by applying the so called *"value of scrap"* compiled by worldsteel.

The amount of metal which is credited to show the benefits of recycling is compiled from the recycling rate (Y tonne recycled per tonne metal product, see Figure 3.1). For steel, the recycling rate is typically about 90-95%, but also depend on the steel product. The data to be used in the calculations in the TraceMet pilot are further specified and described in the SMAD document.

The reasons for introducing this carbon footprint measure are described below and is based on steel production:

- To only look at the cradle to gate impact for steel is misleading. When comparing steel produced via the blast furnace (BF) and electric arc furnace (EAF) routes, without taking the scrap into consideration, the BF steel comes out as the worst alternative since the EAF based steel is produced from scrap. However, recycled steel scrap is a limited resource and there is not enough scrap on the market and the demand for steel is predicted to grow for several decades ahead. Therefore, in the foreseeable future virgin steel will still be needed.
- Iron ore-based steel enables recycling:
    - Steel scrap has significant economic value, which means that where scrap is recovered it will be used for recycling
    - There is no requirement to create a demand for recycled material as this market is already well established
    - The magnitude of steel recycling is driven by end of life recycling rates
    - The demand for steel scrap exceeds the availability of the scrap
    - Designing products for easier end of life disassembly and recycling will enable more steel scrap to be recycled
    - From a policy perspective, this method leads to a focus on recycling at end of life and promotes the concepts of the circular economy.

Therefore, a measure covering this broader perspective has been defined in the TraceMet methodology.

1.4 REPORTING

In this chapter general rules for the reporting is described. In the SMAD chapters specific rules for the specific core CoC metal product is found.

For the reporting one of the two options shall be chosen:

Option A (for reporting on core CoC metal or metal product)

1. Amount of produced core CoC metal or metal product (tonnes).
2. If applicable: Purchased amount of core CoC metal or metal product (tonnes)
3. Post-consumer recycled content (%) or pre-and post-consumer recycled content (%) or both
4. Carbon footprint for the core CoC metal or metal product (CO_2e)

Option B (for cases when the company wishes to report on core CoC primary metal or metal product + recycled core metal or metal product

1. Amount of produced of core CoC primary metal or metal product (tonnes)
2. Amount of recycled core metal or metal product (tonnes)
3. If applicable: Amount of purchased core CoC metal or metal product (tonnes)
4. Carbon footprint for the core CoC primary metal or metal product according to this PCR (which is in line with EN 15804 modules A1-A3) (CO_2e)
5. Carbon footprint for the recycled CoC metal or metal product according to this PCR (which is in line with EN 15804 modules A1-A3) (CO_2e)

In addition, and for both options it is allowed to report

Net-GWP impact (carbon footprint) over the whole life cycle: Carbon Resource Management (CO_2 eq), thus including system expansion in the end-of- life phase of the final CoC metal product.

The core CoC company reports their own measured and calculated data only including its upstream processes as described in chapter 1.2.3.

2 SPECIFIC METHODS, ASSUMPTIONS AND DATA (SMAD) FOR STEEL, HOT ROLLED COIL

2.1 VALIDITY

The products for which this SMAD is valid is:

Steel hot rolled coil from the LKAB mine in Malmberget and SSAB steel production in Luleå and subsequently Borlänge.

2.2 METHOD RULES

2.2.1 General data collection instruction

All data collection shall be in line with the TraceMet PCR where for example definitions of the recycled content and the carbon footprint measures are, see chapter 1.

If a company reports their carbon footprint (scope 1 emissions in line with chapter 1.2.3) to the EU-ETS system (EU-ETS, 2020) and/or GHG protocol system (GHG protocol, 2020), these data shall, if possible, be used in the calculations in the CoC. The reason is because this reporting is made annually and in the TraceMet PCR, data for core processes are reported annually. It is important to check whether the rules in the TraceMet PCR are met before using these data. It may, for example, be so that emission factors need to be adjusted to the TraceMet reporting.

If the company does not report according the EU-ETS and/or GHG protocol, the scope 1 emissions shall be calculated based on the use of fuels (or other carbon sources relevant for the process) and by applying emission factors for the GHG emissions.

The auditor shall be allowed to revise the calculations, including data sources, references and assumptions made.

For the upstream data applied for production of materials and fuels (scope 3 in line with chapter 1.3.2) and electricity production (scope 2 in line with chapter 1.3.2), a well-documented and transparent LCA calculation shall be applied, which could be third-party reviewed. If it is open for revision, then report so. If the report is not open for revision, meta data for the materials and general information about the methodology for the LCA shall be reported in SMAD. The auditor shall be allowed to revise the LCA model, including data sources, references and assumptions made.

It is important to avoid double counting. Therefore, note that data for upstream companies that are part of CoC shall be subtracted from the data based on an LCA or LCA calculation. Also, data for the companies' own facilities (scope 1) involved in the CoC of the metal product shall be subtracted, if scope 1 are reported separately in the TraceMet reporting.

Allocation and, if needed, mass-balance calculations shall be used in order to calculate the carbon footprint of the core CoC metal product.

The total carbon footprint is compiled based on data for the core process and by adding the upstream data for production of energy and raw materials as well as transportation of scrap and raw materials to the site. See figure 2.1.

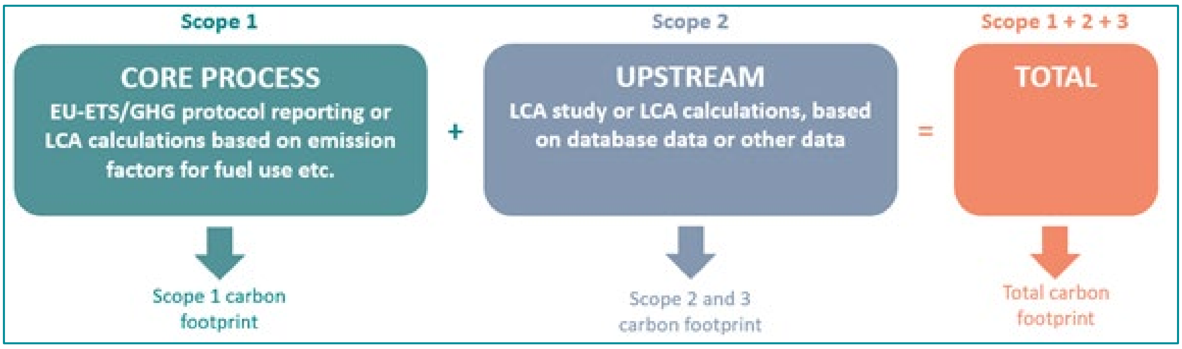


Figure 2.1. Sources of data for calculation of carbon footprint and how they relate to scopes according to the reporting to the EU-ETS system with its divisions into scopes but also in line with the TraceMet PCR.

The declared unit is **1 tonne** of metal product.

2.2.2 ALLOCATION RULES FOR STEEL

2.2.2.1 (LKAB) Producer of iron pellets

Allocation is not relevant for LKAB.

2.2.2.2 (SSAB) Steel producer of hot rolled coil

The steel considered in this pilot study is carbon steel produced from iron ore via the blast furnace (BF) route. Stainless steel or low alloyed steel produced from scrap and virgin alloys via the electric arc furnace (EAF) route have not been considered in this pilot study.

BF route-based steel making generates co-products such as:

- Process gases generated in the BF and the BOF
- Slags, sludge and dust generated in the BF and the BOF

Part of the process gases are used as internal fuel in the downstream processes or for generation of internal electricity and the excess (if relevant) is used to produce electricity and heat sold externally.

The recommended methodology by worldsteel is to apply system expansion prior to allocation for the generated co-products. Since this is not allowed in EPDs, worldsteel has developed and published an allocation approach for allocation between the steel and the co-products. The method is rather complex and is divided in allocation of inputs and outputs in the blast furnace and in the basic oxygen furnace. Furthermore, some very detailed site-specific data collection procedures are required for calculation of quite a number of site-specific allocation factors for different inputs and outputs to and from these two processes.

Also considering that the LCA models for steel making are rather detailed and complex, it would require a huge effort to apply this allocation approach.

It is therefore optional to carry out co-product allocation for steel according to the TraceMet methodology. If allocation is made, the worldsteel allocation approach shall be applied and it could also be used to a certain extent e.g. only for the process gases, which would mean that the environmental impact connected to the other co-products would be 100% allocated to the steel (a conservative approach).

2.3 DATA AND ASSUMPTIONS

This section contains information about the data used in the TraceMet pilot and on an overall level how the data have been collected and compiled.

Only data reported for the production sites of the companies taking part in the CoC in this TraceMet pilot study are verifiable by the auditor. Thus, for example the data for the electricity production are not to be verified by the auditor but the LCA study containing data for the electricity production shall be third party reviewed.

The actual data values are presented in appendix A.

2.3.1 Recycled content

2.3.1.1 LKAB iron pellets production

Recycled content is not relevant for the iron pellets production.

2.3.1.2 SSAB steel production

The data applied to compile the recycled content for the production of hot rolled steel produced by SSAB is based on the EPDs published in 2020 (SSAB EPD, 2020). IVL was the LCA consultant in this EPD project and has access to the LCA models and detailed background data.

For steel both measures for recycled content defined in the TraceMet PCR were calculated and reported (Figure 2.2).

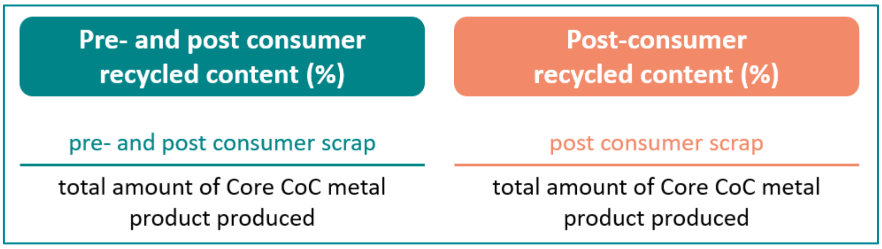


Figure 2.2: Definition of pre- and post-consumer recycled content as well as post-consumer recycled content in the TraceMet methodology.

The actual compilations and data values can be found in appendix A.

2.3.2 Carbon footprint

2.3.2.1 LKAB iron pellets production

Carbon footprint for the core CoC iron pellet product

The carbon footprint calculation for the iron pellets produced by LKAB is illustrated in Figure 2.3.

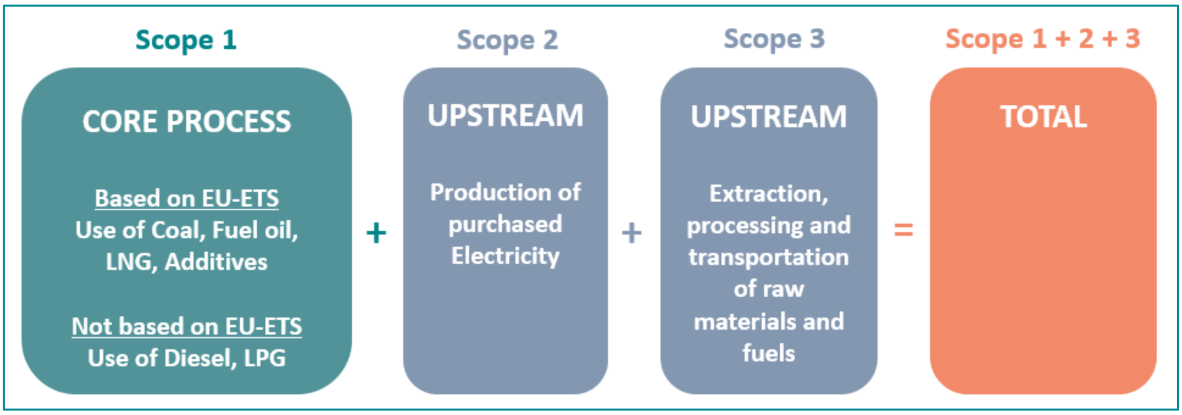


Figure 2.3 Carbon footprint calculation for the iron pellets produced by LKAB.

The core process covers extraction of iron ore at the mine in Malmberget, producing the two iron pellet qualities MPBA and MPBO. The majority of the MPBO is purchased by SSAB.

The GHG emissions from the use of fuels are based on the EU-ETS reporting (scope 1), except for diesel and LPG, which are calculated based on standard emission factors. Scope 1 also covers direct site-specific emissions from additives (raw materials), which release carbon dioxide in the process.

For the production of the purchased electricity (scope 2) generic data have been applied. The electricity is sourced via a Guarantees of Origin certificate and the electricity source is a mix of hydro power and nuclear power (40/60) in 2019.

The production of raw materials and fuels as well as relevant transportation (scope 3) are based on generic data and data from the supplier when available.

The carbon footprint calculations for both scope 2 and 3 have been carried out in an LCA study (CFP tool). This LCA also covers scope 1, but LKAB can provide the different values separated from each other.

The data are based on the production in 2019.

The actual compilations and data values can be found in appendix A.

2.3.2.2 SSAB steel production

Background

The data applied to compile the carbon footprint for the production of hot rolled steel strip produced by SSAB is based on the EPDs published in 2020 (SSAB EPD 2020). The data are based on the production in 2017.

Carbon footprint for the core CoC metal product

The EPDs are based on a cradle to gate LCA, which means that in addition to the SSAB site specific emissions, the production of raw materials, energy etc. are also covered.

The data can be divided in two categories;

- site specific carbon dioxide emissions provided by SSAB. These should be based on verified data from the EU-ETS reporting. According to the TraceMet PCR, these data shall be updated annually.
- data provided by SSAB for use of raw materials and energy as well as transportation of raw materials and scrap, which in the LCA have been modelled by using generic data from databases. According to the TraceMet PCR, these data shall be updated within 10 years for generic data and within 5 years for supplier specific data.

In the TraceMet pilot, the producer of the iron pellets (LKAB) provides their own data. The EPD data were therefore adjusted to exclude the iron pellets production.

The actual compilations and data values can be found in appendix A.

Carbon resource management carbon footprint

As outlined in the TraceMet PCR, the carbon resource management carbon footprint is compiled by adding the carbon footprint for the core CoC metal product (metal production), the end of life as well as the benefits from recycling (2.4).

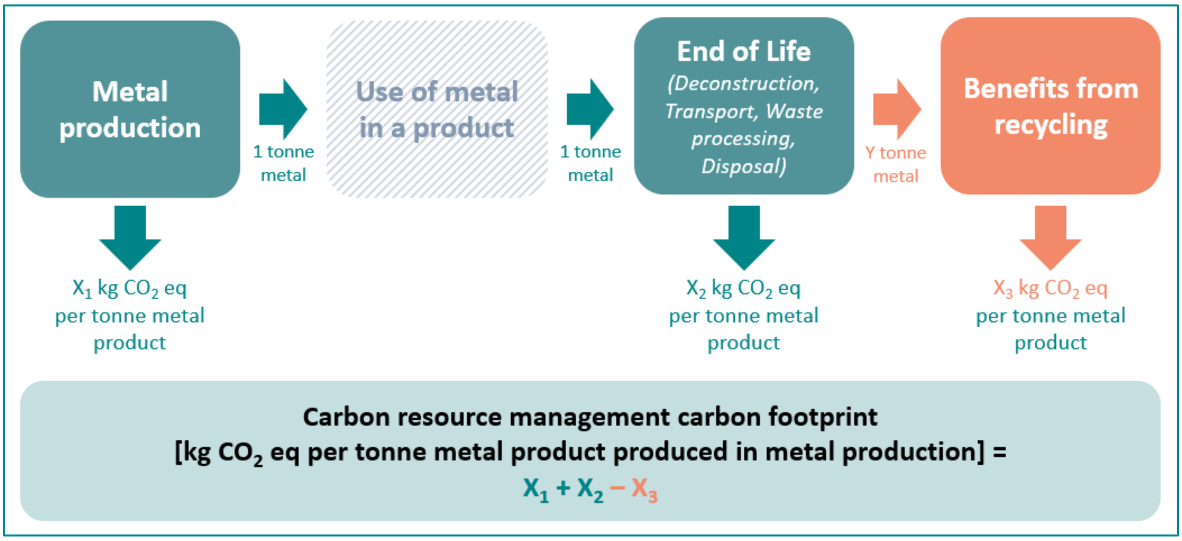


Figure 2.4: Definition of carbon resource management carbon footprint considering the net GWP impact over the entire life cycle in the TraceMet methodology.

The actual compilations and data values can be found in appendix A.

Amount of iron pellets used in the steel production

In order to add the carbon footprint for the iron pellets production at LKAB to the steel production at SSAB, data in terms of amount of iron pellets per tonne steel is required.

The actual compilations and data values can be found in appendix A.

Block chain carbon footprint for steel production

Block chain carbon footprint for the core CoC steel product

The total carbon footprint for the steel product is in the block chain obtained by adding the carbon footprint for the iron pellets production at LKAB with the carbon footprint for the steel production at SSAB (Figure 2.5) see also in more detail in chapter 2.5.

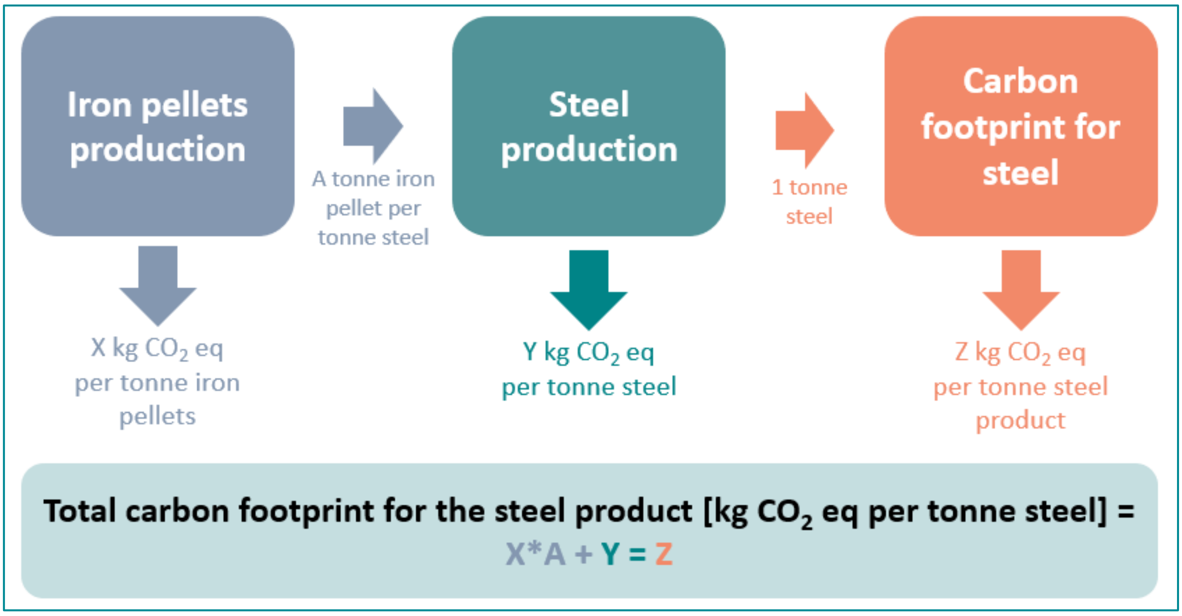


Figure 2.5: Conceptual picture of the total carbon footprint for the steel product.

The actual compilations and data values can be found in appendix A.

Block chain carbon resource management carbon footprint for the core CoC steel product

This is only relevant to calculate for the complete block chain, which in this pilot means that the iron pellets production at LKAB should be added to the steel production at SSAB.

The actual compilations and data values can be found in appendix A.

2.4 REPORTING

Below is listed what is to be reported to the block chain. It is in line with the choices in the TraceMet PCR chapter 1.

Option A (for reporting on core CoC metal or metal product)

LKAB and SSAB report according to this option

5. Amount of produced core CoC metal or metal product (tonnes).
6. If applicable: Purchased amount of core CoC metal or metal product (tonnes)
7. Post-consumer recycled content (%) or pre-and post-consumer recycled content (%) or both (SSAB reports both)
8. Carbon footprint for the core CoC metal or metal product (CO_2e)

The names of the core metal products are for

- LKAB: Iron ore pellets and
- SSAB: Steel, hot rolled coil

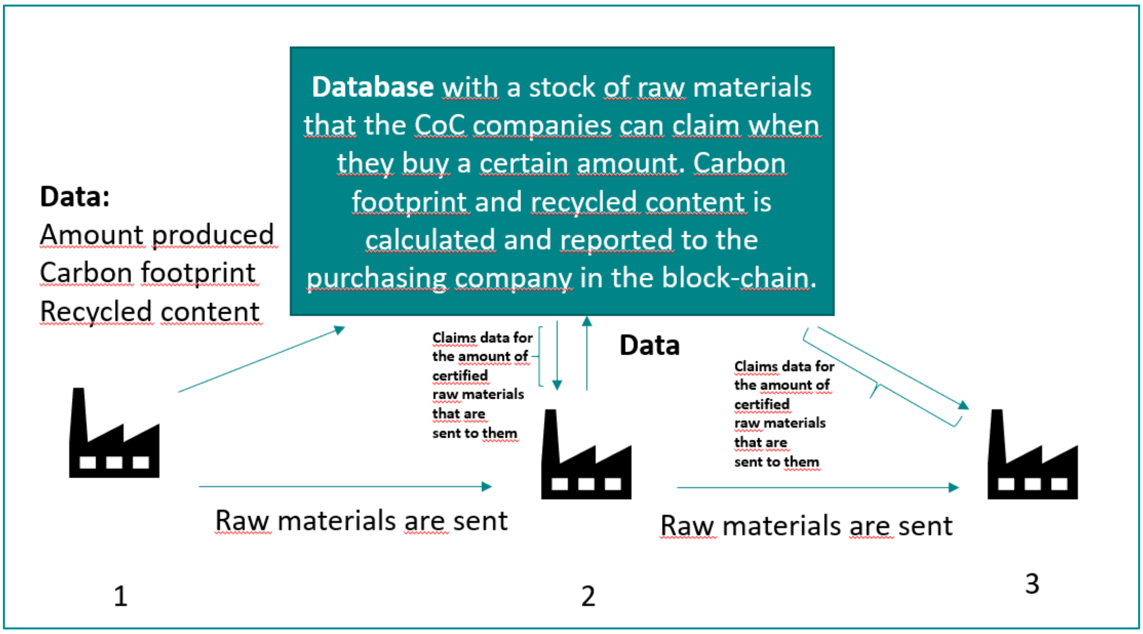
In addition, and for both options it is allowed to report Net-GWP impact

Net-GWP impact (carbon footprint) over the whole life cycle: Carbon Resource Management (CO_2e), thus including system expansion in the end-of- life phase of the final CoC metal product.

SSAB reports according to this option, as a complement

2.5 CALCULATIONS IN THE BLOCK-CHAIN

Data from and to the companies are handled in the block-chain. See figure 2.6 for a general picture about the data and material flows.



Database with a stock of raw materials that the CoC companies can claim when they buy a certain amount. Carbon footprint and recycled content is calculated and reported to the purchasing company in the block-chain.

Figure 2.6. A general picture of the flows of data and raw materials in the block-chain.

The block-chain data are calculated in a decentralized database. Data are reported in the order in time that LKAB reports first (no1) and after that SSAB (no2). Data for carbon footprint from company 1 (LKAB) and company 2 (SSAB) are summarized and the total is reported as Carbon footprint for the core metal product (steel, hot rolled coil, CO2e). Since LKAB reports iron pellets rescaling is done according to the description below. The recycled content, however, is logically not summarized for LKAB and SSAB.

The blockchain maintains accounts of masses of certified materials in possession of production facilities.

A lot of material is specified as a type of material (eg copper cathodes) and a mass in tons as well as its location at a specified production facility.

A lot of material may also be associated with certified measures (numbers) of carbon footprint given as kgs of CO_2-equivalents per ton of material and amount of recycled metal, given as a percentage of the mass. These numbers are reported by the companies as they report production. The blockchain software will ask for these numbers in a production report if the configuration of the production facility on the blockchain specifies that such reporting is required.

A lot may contain multiple measures of carbon footprint (resulting from multiple processing steps in a value chain) and multiple measures of recycled content (resulting from reporting multiple kinds of recycled metal).

A production report to the blockchain specifies the amount of produced material and amounts of certified materials which were consumed from mass balance accounts. The effect is that the consumed material amounts are reduced from the accounted material lots on the blockchain and the produced materials are added to the accounted lots.

For the carbon footprint, the carbon footprint numbers reported for the produced lot are associated directly to the produced material lot on the blockchain accounts.

In addition, the blockchain software will rescale the carbon footprint values of any consumed materials to ensure that the total amount of carbon footprint from the inputs in aggregate is preserved and accounted for on the newly accounted produced material lot. Each carbon footprint measure on the input material lots is scaled so the carbon footprint is measured in terms of the output material mass by multiplying it with the input mass and dividing with the output mass:

IM = input material lot mass

OM = output material lot mass

CFP_{in}= a carbon footprint value on an input material lot

CFP_{out}= the scaled carbon footprint value on the output material lot

$$CFP_{out} = \frac{CFP_{in} * IM}{OM}$$

Measures for recycled content are stored by the blockchain on material lots, but not scaled or processed in any other way.

The values for recycled content provided in the production report are associated with the material lot on the blockchain. Any values of recycled content in input materials are not carried over to the output material by the blockchain, instead the companies will themselves calculate the resulting totals based on the input values they received on the blockchain and the amount of recycled metal added in the production process. The reason for this is that the blockchain is not used for tracing scrap so the blockchain does not know the amount of recycled metal added in a production process so it cannot calculate the final total.

In the case of the steel value chain, the first company, LKAB, will extract ore from nature and refine it to iron ore pellets. Thus, there are no input materials in the report by LKAB, only the output of the pellets and the CF value. Consider an example case where LKAB produces a (fictitious) lot of 29.8 tonnes of pellets. The blockchain will account for the mass and the recycled content of the lot.

Material	**Mass**	**Certified values**
Iron ore pellets	29.8 tonnes	CF: 36 kg CO_2eq / tonne

SSAB will receive the lot of pellets and make steel out of them. SSAB will report their contribution to the carbon footprint and calculate and report two different measures of recycled content. The blockchain will scale the CF values from the ore. For the sake of example, let there be 20 tons of steel produced. Consider the following example.

There will be 20 tonnes of steel.

The recycled content is 20% and 2.6% based on the two measures, pre- and postconsumer and post-consumer respectively.

The CF value from the pellets is scaled as 36 * 29.8 / 20 = 53.6 since there has been 36 * 29.8 kg of CO_2eq emitted for the production of the first lot distributed over 20 tonnes of steel

Let the contribution from SSAB to the CF be 2041 kg CO_2eq / tonne steel.

Thus, the steel accounted for on the blockchain will be the following:

Material	**Mass**	**Certified values**
Steel	20 tonnes	CF: 53.6 kg CO_2eq / tonne steel from production of iron pellets CF: 2041 kg CO_2eq / tonne steel from steel production Recycled content: 20%, pre- and postconsumer Recycled content: 2.6%, post-consumer

Note that the blockchain software does not sum up the individual CF values on the blockchain. While it is intended to sum up the CF values if each individual value is produced according to the

TraceMet PCR and SMAD, the blockchain software does not yet have the mechanism for indicating whether a series of CF values are verified according to the same TraceMet PCR and SMAD and therefore can be summed up accordingly. When using the blockchain pilot software, CF values therefore needs to be summed up manually and the result be entered manually into the correct field into the blockchain system. Please note that when entering a new or updated value into the blockchain such a value needs to be verified according to the TraceMet certification scheme for it to be valid.

3 SPECIFIC METHODS, ASSUMPTIONA AND DATA (SMAD) FOR COPPER, WIRE ROD

3.1 VALIDITY

The product for which this SMAD is valid is:

Copper wire rod with origin from Boliden's mines and purchased copper scrap and Elektrokoppar's production of copper wire rod with the copper cathode material from Boliden's smelter Rönnskärsverken.

3.2 METHOD RULES

3.2.1 General data collection instruction

All data collection shall be in line with the TraceMet PCR requirements Definitions of the recycled content and the carbon footprint measures are found in the PCR in chapter 1.

If a company reports their carbon footprint (scope 1 emissions in line with the TraceMet PCR) to the EU-ETS system (EU-ETS, 2020) and/or GHG protocol system (GHG protocol, 2020), these data shall, if possible, be used in the calculations in the CoC. The reason is because this reporting is made annually and in the TraceMet PCR, data for core processes are reported annually. It is important to check whether the rules in the TraceMet PCR are met before using these data. It may, for example, be so that emission factors need to be adjusted to the TraceMet reporting.

If the company does not report according the EU-ETS and/or GHG protocol, the scope 1 emissions shall be calculated based on the use of fuels (or other carbon sources relevant for the process) and by applying emission factors for the GHG emissions.

The auditor shall be allowed to revise the calculations, including data sources, references and assumptions made.

For the upstream data applied for production of materials and fuels (scope 3 in line with the TraceMet PCR) and electricity production (scope 2 in line with the TraceMet PCR), a well-documented and transparent LCA calculation shall be applied, which could be third-party reviewed. If it is open for revision, then report so. If the report is not open for revision, meta data for the materials and general information about the methodology for the LCA shall be reported in SMAD. The auditor shall be allowed to revise the LCA model, including data sources, references and assumptions made.

It is important to avoid double counting. Therefore, note that data for upstream companies that are part of CoC shall be subtracted from the data based on an LCA or LCA calculation. Also, data for the companies' own facilities (scope 1) involved in the CoC of the metal product shall be subtracted, if scope 1 are reported separately in the TraceMet reporting.

Allocation and, if needed, mass-balance calculations shall be used in order to calculate the carbon footprint of the core CoC metal product.

The total carbon footprint is compiled based on data for the core process and by adding the upstream data for production of energy and raw materials as well as transportation of scrap and raw materials to the site. See figure 3.1.

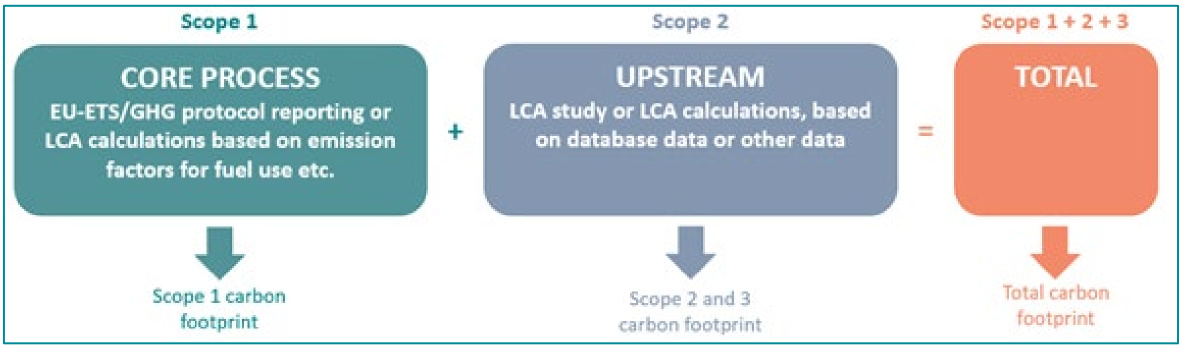


Figure 3.1. Sources of data for calculation of carbon footprint and how they relate to scopes according to the reporting to the EU-ETS system with its divisions into scopes but also in line with the TraceMet PCR.

The declared unit is **1 tonne** of metal product.

3.2.2 Allocation rules for copper

3.2.2.1 Allocation rules for copper cathode produced at Boliden's smelting facility Rönnskärsverken

These rules regard the activities at Boliden's smelting facility Rönnskärsverken They regard calculations for the EU-ETS, GHG protocol calculations and reporting.

The rules for metal outputs and inputs are based on relevant ISO standards and a scientific article for LCA methodology for the metal and mining industry (Santero and Hendry, 2016) which are in line as with ISO 14040 and 44.

Mass of metal allocation

Mass of metal allocation is done when the economic value per unit of output between co-products is similar. According to EN 150804 (CEN, 2013 and 2019), relatively small is defined as less than a 25% difference in value per kg.

Economic allocation

This method should only be applied for products priced on a global market in order to be comparable and harmonized over the industry. Thus, not for Acid and Iron-Silicates, since they are regionally priced. If the price difference is 25 % or more on a 10-year average period economic allocation shall be done.

Avoidance of allocation by system expansion

System expansion is allowed for co-products if needed, and it is done for the production of sulfuric acid and energy since they are not priced on a global market.

Application of the allocation method

The allocation of the greenhouse gas emissions to each metal produced is done in 3 steps:

1. Define the system boundary
2. Identify shared processes within system boundary
    a) Identify process steps within the boundary where greenhouse gas emissions can be allocated based on mass
3. Identify co-products within each boundary
    b) Identify co-products within the boundary where greenhouse gas emissions can be allocated based on mass
    c) Identify co-products of value to where greenhouse gas emissions shall be allocated based on market value

Mass-balance

When mass-balance calculations are needed for inputs of metal in focus other than from companies in the Chain of Custody the rules for mass and economic allocation above shall be applied

Detailed description of the allocation rules

The allocation methodology is entirely based on the methodology developed by Boliden. In appendix B specifications of their allocation methods are found.

3.2.2.2 Allocation rules for copper wire rod at Elektrokoppar

Allocation of the carbon footprint shall be in accordance with the rules in chapter 1.2.4 (the PCR). Since there is currently no LCA study available, the decision regarding which allocation method to use is not yet done.

3.2.3 Mass-balance calculations of copper

If other core metals from producers that do not take part in the CoC are included, mass-balance calculations are needed.

3.2.3.1 Mass-balance calculations at Boliden for production of copper cathode

In order to separate GWP for the products produced solely from Boliden owned mines, secondary sources and other external mines and smelters a mass balance principle is applied. The fundamentals of the mass balance principle are that the volume of claimed material that enters the process is equivalent to the volume of claimed material leaving (the process). In the Boliden smelting & refining unit process steps, a mass-based allocation is applied to identify emissions relevant to primary and secondary material.

These calculations are to be documented in a transparent way for facilitating a revision.

3.2.3.2 Mass-balance calculations at Elektrokoppar for the production of copper wire rod

Mass-balance calculations are required for the reporting of the used copper purchased from Boliden for the CoC. These calculations shall be documented in a transparent way for facilitating a revision.

3.3 DATA AND ASSUMPTIONS

This section contains information about the data used in the TraceMet pilot and on an overall level how the data have been collected and compiled.

Only data reported for the production sites of the companies taking part in the CoC in this TraceMet pilot study are verifiable by the auditor. Thus, for example the data for the electricity production are not to be verified by the auditor but the LCA study containing data for the electricity production shall be third party reviewed.

The actual data values are presented in appendix C.

3.3.1 Recycled content

3.3.1.1 Boliden copper cathode production

Boliden reports amount of primary copper cathode produced from their own copper mines and secondary copper separately to the CoC. The secondary copper regards post-consumer scrap and the amount reported shall reflect the average recycled content in the copper cathode produced by Boliden, thus mass balance calculations are needed for the reporting.

3.3.1.2 Elektrokoppar copper wire rod production

The recycled content of copper in the copper wire rod shall verifiably reflect the recycled content in the CoC of the copper product.

Mass-balance calculations are needed for the reporting, since they buy copper from different producers, not only Boliden.

3.3.1.3 Boliden copper production

Meta-data from the LCA study from where the upstream data are to be picked

Boliden received their ordered LCA study in 2020 regarding their copper production which is used for upstream data. If, however the production volume changes, data from the LCA have to be scaled accordingly.

To conduct an LCA study for copper in Rönnskär smelter which is a highly complex multi-metal producer, allocations rules based on the GHG Product Life Cycle Accounting and Reporting Standard and ISO 14064 standards has been implemented which are in line with the TraceMet PCR (2020).

The goal of the LCA study was to provide diverse stakeholders with the carbon footprint of the copper produced and enable internal workers to improve the smelting processes and reduce the carbon footprint both on a Scope 1, 2 and 3 emissions.

The scope was from cradle-to-gate. The functional unit has been decided to greenhouse gas emissions /tonne of copper produced through the impact category GWP 100 years. Several assumptions were made and when the overall data was available but not for a specific process and when emissions from suppliers were not available, a global average number was used as an approximation. See table for some assumptions in appendix C.

The data quality requirement is high due to the goal of the project however, there are of course several limitations e.g. the majority of Scope 3 emissions are based on global average numbers, some databases do not represent the processes of Boliden, data have been gathered from several different people which could lead to quality of data is based on the person providing it. The study has been third party reviewed by Intertek.

3.3.1.4 How total carbon footprint is calculated

Boliden calculates its carbon footprint according to the rules in chapter 3.2 for its core processes. Carbon footprint for the upstream processes is calculated by using the LCA study presented in chapter 3.3.1.3 and subtracting the carbon footprint from the core processes. The carbon footprint values for the core and upstream processes are thereafter summarized.

3.3.1.5 Elektrokoppar copper wire rod production

Elektrokoppar calculates carbon footprint according to the rules in chapter 3.2.

3.4 REPORTING

Below is listed what is to be reported to the block chain. It is in line with the choices in the TraceMet PCR in chapter 1.

Option A (for reporting on core CoC metal or metal product)

Elektrokoppar reports according to this option

9. Amount of produced core CoC metal or metal product (tonnes).
10. If applicable: Purchased amount of core CoC metal or metal product (tonnes) (Elektrokoppar only)
11. Post-consumer recycled content (%) or pre-and post-consumer recycled content (%) or both (in the case for Elektrokoppar: post-consumer recycled content)
12. Carbon footprint for the core CoC metal or metal product (CO2e)

The name of the core metal product is for Elektrokoppar: Copper wire rod.

Option B (for cases when the company wishes to report on core CoC primary metal or metal product + recycled core metal or metal product

Boliden reports according to this option with separate reporting of primary and recycled copper. This principle is preferred, as the sources of emissions becomes more visual (eg. Combustion of plastics in electronic scrap) and the carbon footprint data for mined minerals is more comparable to peers.

1. Amount of produced of core CoC primary metal or metal product (tonnes)
6. Amount of recycled core metal or metal product (tonnes) that corresponds to the calculated average recycled content of CoC core metal or metal product in the production at the site (here Boliden).
7. If applicable: Amount of purchased core CoC metal or metal product (tonnes) (not reported by Boliden)
8. Carbon footprint for the core CoC primary metal or metal product according to this PCR (which is in line with EN 15804 modules A1-A3) (CEN, 2013 and 2019) (CO2e)
9. Carbon footprint for the recycled core metal or metal product according to this PCR (which is in line with EN 15804 modules A1-A3) (CEN, 2013 and 2019) (CO2e)

The name of the Boliden product is: Copper cathode

In addition, and for both options it is allowed to report Net-GWP impact.
Net-GWP impact (carbon footprint) over the whole life cycle: Carbon Resource Management (CO_2e), thus including system expansion in the end-of- life phase of the final CoC metal product.

3.5 CALCULATIONS IN THE BLOCK-CHAIN

Data from and to the companies are handled in the block-chain. See figure 3.2 for a general picture about the data and material flows.

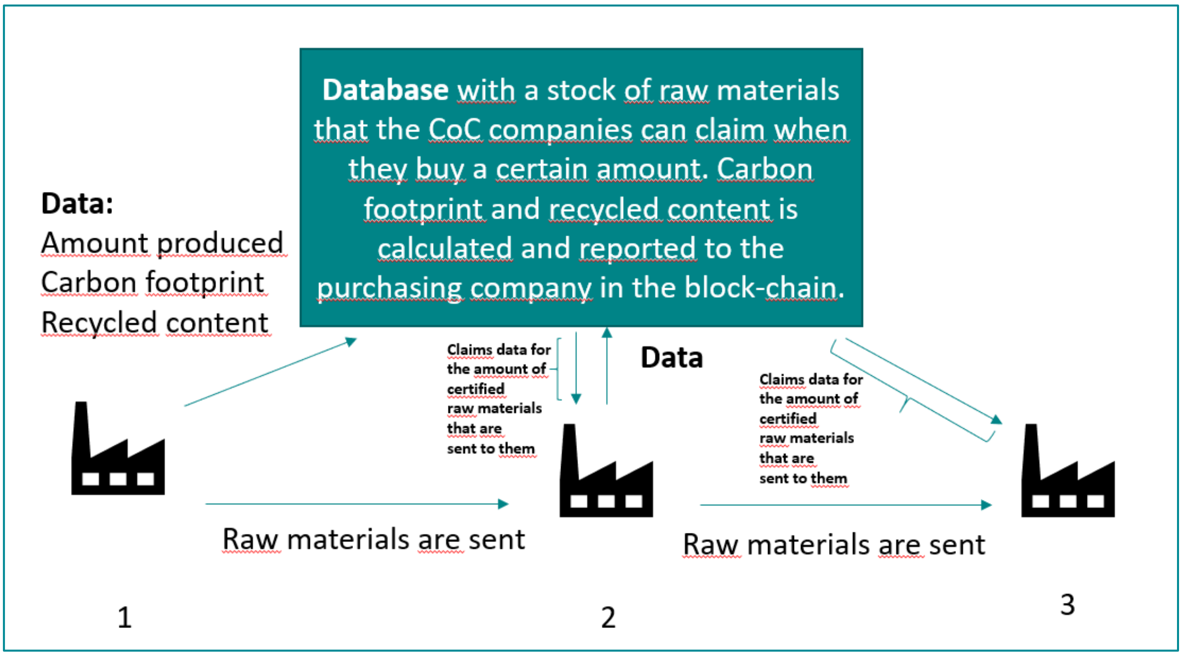


Figure 3.2. A general picture of the flows of data and raw materials in the block-chain.

The block-chain data are calculated in a decentralized database. Data are reported in the order in time that Boliden reports first (no1) and after that Elektrokoppar (no2). Data for carbon footprint from company 1 (Boliden) and company 2 (Elektrokoppar) are summarized and the total is reported as Carbon footprint for the core metal product (copper wire rod, CO2e). The reported post-consumer recycled content by Elektrokoppar is on the other hand calculated by the company as explained in chapter 4.1.2.

The blockchain includes possibilities for rescaling as described below.

The blockchain maintains accounts of masses of certified materials in possession of production facilities.

A lot of material is specified as a type of material (eg copper cathodes) and a mass in tons as well as its location at a specified production facility.

A lot of material may also be associated with certified measures (numbers) of carbon footprint given as kilograms of CO2-equivalents per ton of material and amount of recycled metal, given as a percentage of the mass. These numbers are reported by the companies as they report production. The blockchain software will ask for these numbers in a production report if the configuration of the production facility on the blockchain specifies that such reporting is required.

A lot may contain multiple measures of carbon footprint (resulting from multiple processing steps in a value chain) and multiple measures of recycled content (resulting from reporting multiple kinds of recycled metal).

A production report to the blockchain specifies the amount of produced material and amounts of certified materials which were consumed from mass balance accounts. The effect is that the consumed material amounts are reduced from the accounted material lots on the blockchain and the produced materials are added to the accounted lots.

For the carbon footprint, the carbon footprint numbers reported for the produced lot are associated directly to the produced material lot on the blockchain accounts.

In addition, the blockchain software will rescale the carbon footprint values of any consumed materials to ensure that the total amount of carbon footprint from the inputs in aggregate is preserved and accounted for on the newly accounted produced material lot. Each carbon footprint measure on the input material lots is scaled so the carbon footprint is measured in terms of the output material mass by multiplying it with the input mass and dividing with the output mass:

IM = input material lot mass

OM = output material lot mass

CFP_{in}= a carbon footprint value on an input material lot

CFP_{out}= the scaled carbon footprint value on the output material lot

$$CFP_{out} = \frac{CFP_{in} * IM}{OM}$$

Measures for recycled content are stored by the blockchain on material lots, but not scaled or processed in any other way.

The values for recycled content provided in the production report are associated with the material lot on the blockchain. Any values of recycled content in input materials are not carried over to the output material by the blockchain, instead the companies will themselves calculate the resulting totals based on the input values they received on the blockchain and the amount of recycled metal added in the production process. The reason for this is that the blockchain is not used for tracing scrap so the blockchain does not know the amount of recycled metal added in a production process so it cannot calculate the final total.

In the case of the copper value chain in the Chain of Custody, the first company, Boliden, will extract ore from nature and refine it to copper cathodes. Thus, there are no input of other primary copper materials in the report by Boliden, only the output of copper and the CF value and the recycled content. Recycled copper enters as scrap, which is not traced on the blockchain further back than Boliden and its calculated emissions according to chapter 3.2.

Consider a fictitious example case where Boliden produces two lots of 87 tons of primary copper and 13 tons of secondary copper. The blockchain will account for the masses, the recycled content and the carbon footprint values of each lot.

Material	Mass	Certified values
Copper	87 tonnes	CF: 996 kg CO2eq / tonne Recycled content: 0 %
Copper	13 tonnes	CF: 1 293 kg CO2eq / tonne Recycled content: 100 %

Elektrokoppar will receive these lots of copper and make wire rod out of them. Elektrokoppar will report their contribution to the carbon footprint and calculate and report the recycled content. The blockchain will scale the CF values from the copper.

There will be 100 tonnes of wire rod.

The recycled content is 13%

The CF value from the first lot is scaled as 996 * 87 / 100 = 866.5 since there has been 996 * 87 kg of CO_2eq emitted for the production of the first lot distributed over 100 tonnes of wire rod.

The CF value from the second lot is scaled as 1293 * 13 / 100 = 168.1 since there is 1293 * 13 kg of CO_2eq in the second lot distributed over 100 tonnes of wire rod.

Let the contribution of CF from Elektrokoppar be 100 kg CO2eq / tonne (fictitious).

Thus, the wire accounted for on the blockchain will be the following:

Material	Mass	Certified values
Copper wire rod	100 tonnes	CF: 866.5 kg CO2eq / tonne (with 0% recycled content) CF: 168.1 kg CO2eq / tonne (with 100% recycled content) CF: 100 kg CO2eq / tonne (from wire rod production, fictitious) Recycled content: 13%

Note that the blockchain software does not sum up the individual CF values on the blockchain. While it is intended to sum up the CF values if each individual value is produced according to the TraceMet PCR and SMAD, the blockchain software does not yet have the mechanism for indicating whether a series of CF values are verified according to the same TraceMet PCR and SMAD and therefore can be summed up accordingly. When using the blockchain pilot software, CF values therefore needs to be summed up manually and the result be entered manually into the correct field into the blockchain system. Please note that when entering a new or updated value into the blockchain such a value needs to be verified according to the TraceMet certification scheme for it to be valid.

4 REFERENCES

4.1 REFERENCES FOR CHAPTER 1, PCR

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World Steel Association (worldsteel) is an industry association, with members in every major steel-producing country, representing steel producers, national and regional steel industry associations, and steel research institutes.

4.2 REFERENCES FOR CHAPTER 2, SMAD FOR STEEL, HOT ROLLED COIL

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TraceMet PCR (2020) *Product Category Rules (PCR) - TraceMet*

World Steel Association (worldsteel) is an industry association, with members in every major steel-producing country, representing steel producers, national and regional steel industry associations, and steel research institutes.

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4.3 REFERENCES FOR CHAPTER 3, SMAD FOR COPPER WIRE ROD

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Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals

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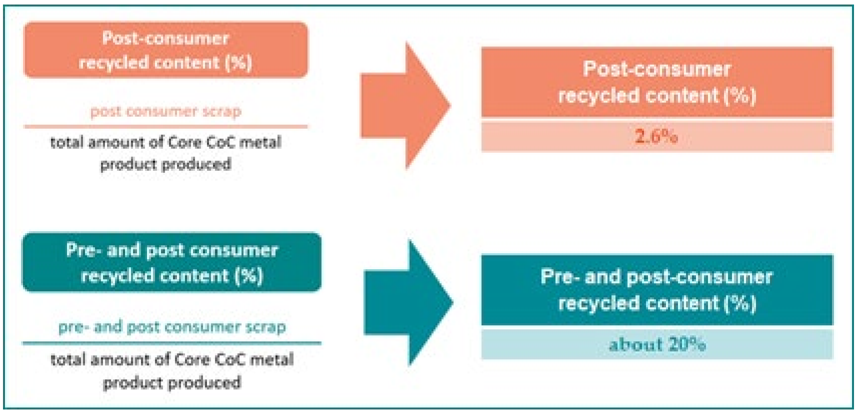
Appendix A. Data used in the pilot for hot rolled steel production

LKAB iron pellets production

Recycled content is not relevant for the iron pellets production.

SSAB steel production

The data on amounts of pre- and post-consumer scrap were provided by SSAB. For steel both measures for recycled content were calculated and reported.



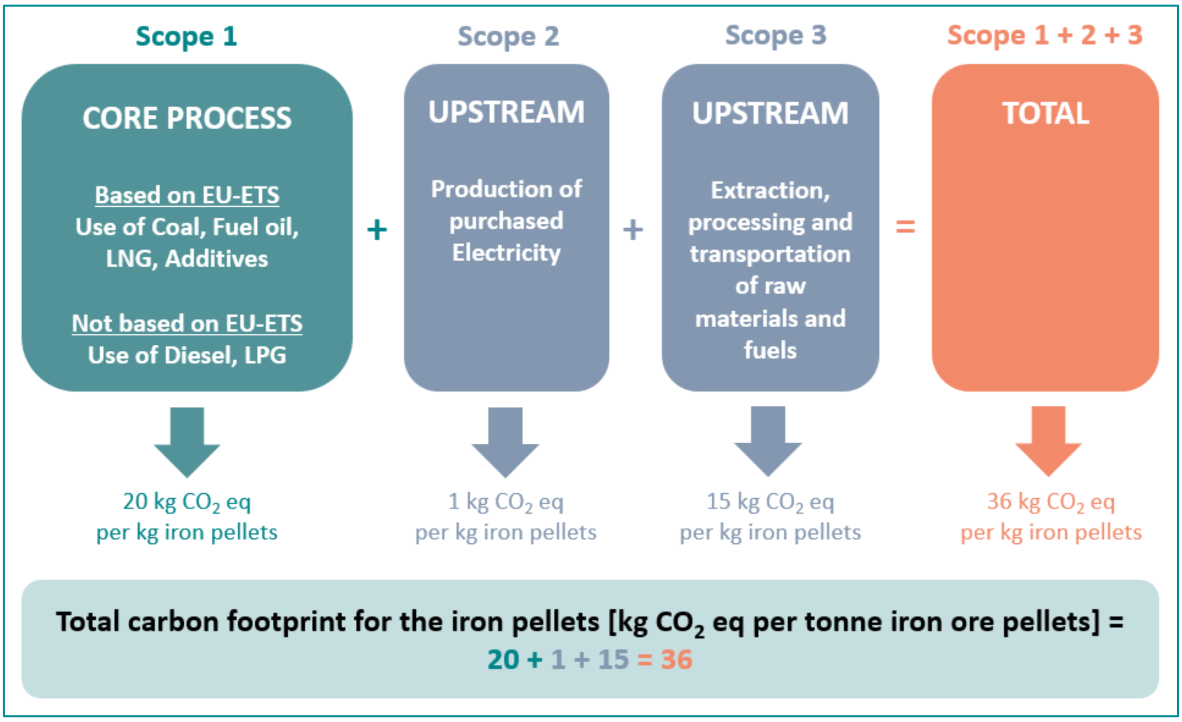
The recycled content background data and compilations can be found in the Excel file "Recycled content_Data_SSAB.xlsx". The data are based on the production in 2017 and is a weighted average on the Nordic production system.

CARBON FOOTPRINT

LKAB iron pellets production

Carbon footprint for the core CoC iron pellet product

The results from the carbon footprint calculation for the iron pellets produced by LKAB is illustrated in the picture below.



Scope 1 corresponds to 56% of the carbon footprint, of which a major part arises from the use of fuels, but the release of carbon dioxide from the use of calcium carbonate is also associated with a quite large contribution

Scope 2 corresponds to only 2% of the carbon footprint.

Scope 3 corresponds to 41% of the carbon footprint.

The data are based on the production in 2019.

Part of the background data and compilations can be found in the Excel file “GWP_Data_LKAB.xlsx”. More details can be found in the Excel file in which the LCA modelling was carried as well as in the LKAB LCA report. This material is however confidential.

SSAB steel production

Carbon footprint for the core CoC steel product

The EPD, on which the data used in the TraceMet pilot are based, is a cradle to gate LCA, which means that in addition to the SSAB site specific emissions, the production of raw materials, energy etc. are also covered.

worldsteel regularly collects data from the steel industry to compile geographical averages for different types of steel products. The LCA which has been applied for the SSAB EPD is based on the worldsteel LCA model corresponding to the data provided by SSAB for production year 2017. The SSAB models were provided by worldsteel as a Gabi LCA software database (worldsteel 2019). There is also a methodology report (worldsteel LCA-report 2019).

Since the LCA practitioner (IVL) did not carry out the LCA as such (including collection of the primary site-specific core data), the data collected by SSAB and provided to worldsteel as well as the data used in the worldsteel models for upstream production, energy etc. are not described in detail in the SSAB LCA report. Data for the core processes (scope 1) were provided by SSAB to worldsteel and the data were also double checked within the EPD project and some minor corrections were made. The data for production of electricity (scope 2) and production of raw materials and fuels (scope 3) applied by worldsteel are mainly based on the Gabi database.

In the TraceMet pilot, the producer of the iron pellets (LKAB) provides their own data. The EPD data was therefore adjusted to exclude the iron pellets production. The table below illustrates the results from the EPD which includes the iron pellets production as well as the carbon footprint used in the TraceMet pilot, where the iron pellets production has been subtracted.

Carbon footprint for the core CoC steel product - hot rolled steel produced by SSAB.

Carbon footprint [kg CO2eq per tonne steel]	SSAB steel including iron pellets production (1)	SSAB steel excluding iron pellets production
SSAB hot rolled steel (weighted average for the Nordic production system)	2 222	1 987

(3) Data are according to the SSAB EPD including the iron pellets production which is based on generic data by worldsteel.

As mentioned in the TraceMet PCR, the GWP method is the version according to the EN15804+A2 standard (CEN (2019)). In the published EPD from SSAB, an older version EN15804+A1 (CEN (2013)) was applied. The GWP value is in the published EPD 2 158 instead of 2 222 kg CO2 eq per tonne i.e. a very small difference.

The carbon footprint value can be divided in two categories;

- site specific carbon dioxide emissions provided by SSAB. These should as far as possible be based on verified data from the EU-ETS reporting.
- the carbon footprint for the upstream production of raw materials and fuels (scope 3), electricity production (scope 2) as well as relevant transportation, have in the LCA been modelled by using generic data from databases etc. However, the iron pellets production has been excluded since the producer of the iron pellets (LKAB) provides their own data. According to the TraceMet PCR, these upstream data shall be updated within 10 years for generic data and

within 5 years for supplier specific data.

The data are based on the production in 2017.

The background data and compilations can be found in the Excel file “GWP_Data_SSAB.xlsx”. Further details can be found in the SSAB EPD LCA report (SSAB LCA report).

Amount of iron pellets used in the steel production

In order to add the carbon footprint for the iron pellets production at LKAB to the steel production at SSAB, data in terms of amount of iron pellets per tonne steel is required.

The use of iron pellets for hot rolled steel production at SSAB as a weighted average on the Nordic market for the production in 2017 is presented in the table below.

Use of iron pellets	Amount [tonne per tonne steel]
Iron pellets (weighted average for the Nordic production system)	1.49

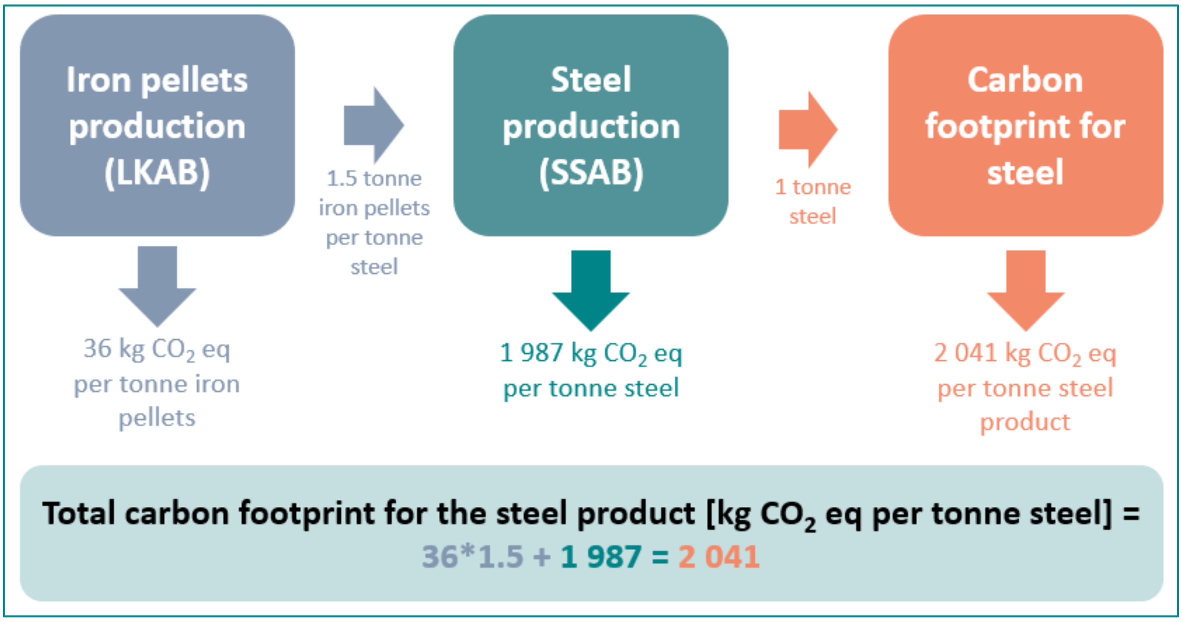
The background data and compilations can be found in the Excel file “GWP_Data_SSAB.xlsx”.

Block chain carbon footprint for steel

The total carbon footprint for the steel product is obtained by adding the carbon footprint for the entire block chain i.e. iron pellets production at LKAB and the carbon footprint for the steel production at SSAB.

Block chain carbon footprint for the core CoC steel product

The total carbon footprint in the value chain for the core CoC steel product is illustrated in the picture below.



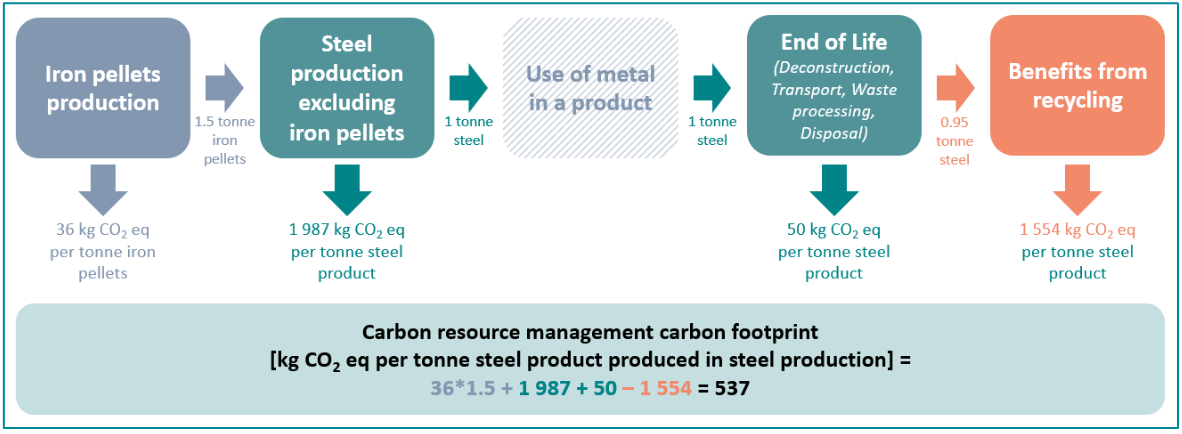
Block chain carbon resource management carbon footprint for the core CoC steel product

The table below illustrates the results from the calculation of the carbon resource management carbon footprint. This is only relevant to calculate for the entire block chain in this pilot i.e. by including the iron pellets production at LKAB.

Carbon resource management carbon footprint - hot rolled steel strip produced by SSAB.

Carbon resource management carbon footprint [kg CO2eq per tonne steel]	LKAB iron pellets production (1)	SSAB steel production excluding iron pellets	End of Life (module C)	Benefits from recycling (module D)	TOTAL
SSAB hot rolled steel (weighted average for the Nordic production system)	54	1 987	50	-1 554	537

This is also illustrated in the figure below. The calculations are based on an assumed recycling rate of 95% i.e. after losses in the end of life treatment and recycling, there is 950 kg of steel to use in the next life cycle.



The carbon footprint for iron pellets production at LKAB and steel production at SSAB was described in the previous sections.

The data applied for the compilation of the end of life phase are illustrated on an overall level in the table below. The detailed data can be found in the SSAB EPD LCA report (SSAB LCA report) as well as in the in the Excel file "GWP_Data_SSAB.xlsx".

Carbon footprint per tonne steel - End of Life (module C)	C1 (Deconstruction) kg CO_2 eq	C2 (Transport) kg CO_2 eq	C3 (Waste processing) kg CO_2 eq	C4 (Disposal) kg CO_2 eq	Total kg CO_2 eq
End of Life (module C)	28.57	17.79	2.62	0.80	49.8

The benefits from recycling is calculated by applying the so called "value of scrap" compiled by worldsteel. This value corresponds to 1.68 kg CO2 eq per kg of scrap in our calculations above. In the most recent EPD it is 1.6 which gives the value in module D: 1480. The amount of scrap to recyling is 950 kg. However, the post-consumer steel scrap input of 26 kg has to be subtracted from this value, ending up at a net amount of scrap to recycling of 924 kg. The calculation is illustrated in the table below.

Carbon footprint per tonne steel - Benefits from recycling (module D)	Recycling rate %	Scrap to recycling after losses in scrap processing in module C kg per tonne	Input of post-consumer steel scrap kg per tonne	Net scrap in module D kg per tonne	Value of scrap, carbon steel (worldsteel 2014) kg CO_2 eq per kg	Benefits from recycling (module D) kg CO_2 eq
Benefits from recycling (module D)	95%	950	26	924	1.68	1 554

The background data and compilations can be found in the Excel file “GWP_Data_SSAB.xlsx”.

Appendix B. Specified allocation methodology for copper cathode production at Rönnskärsverken, Boliden

A ALLOCATION METHODS BACKGROUND

Alternatives of defining emissions from processes to each metal.

A.1 SYSTEM BOUNDARY AND EXPANSION

System expansion considers alternative production routes for the co-products in a system. In practice, system expansion eliminates the co-products from the product system under study by subtracting the inventory of a functionally equivalent product produced by an alternative, mono-output process. Because system expansion avoids the need for allocation, it is generally considered a preferred method of dealing with co-products in a system. However, for some co-products, no mono-output production routes are available, which makes it infeasible to apply this method as you cannot avoid allocation by using a process inventory that is based on allocation itself. Many metals are always produced in shared processes, so it is impossible to identify an alternative production route that is both independent of other metals and representative of industry production practices. In these cases, allocation must be used to distribute the impacts of the shared process (Santero & Hendry 2016).

A.2 MASS OF METAL ALLOCATION

This is generally preferred when the economic value per unit of output between co-products is similar, as the mass remains relatively constant over time, while the market is subject to fluctuations. According to EN 15804 (CEN, 2013 and 2019), relatively small is defined as less than a 25% difference in value (CEN, 2013, Santero & Hendry, 2016)].

a) **What?** Allocate the greenhouse gas emissions based on the weight of the raw material and the containing metals.

b) **How?** For each element, allocate the greenhouse gas emissions from the process based on weight.
As an example: In case the weight of copper compared to other coproducts in the input is 40%, then allocate 40% of the greenhouse gas emissions to copper, e.g. 40 tonne of 100 tonnes material is smelted for copper. Then allocate 40% of the emissions to copper.

A.3 ECONOMIC ALLOCATION

Revenue generation is the driving force behind industrial operations. Allocating based on the economic purpose of performing a given activity is known as economic (market) allocation. Using this approach, total impacts are allocated with respect to the economic value of the individual outputs. The market values of the outputs are averaged over a certain time period; longer periods are recommended in order to reduce the impact of random price spikes and drops. This harmonization document recommends that a 10-year average is used; other time spans can be used as long as the price data represents economically current information that minimizes the effect of volatility. In metal systems where precious and base metals are mined as the same ore deposit, economic allocation is often the preferred allocation method. In these situations, mass allocation fails to adequately capture the main purpose of processing the ore and its downstream operations. Conversely, economic allocation captures the driver of this process (economic revenue) and uses that information to distribute the impacts.

This method should only be applied for products priced on a global market in order to be comparable and harmonized all over the industry. Hence, not for Acid and Iron-Silicates, since they are regionally priced.

a) **What?** Allocate greenhouse gas emissions based on value of metals produced.
b) **How?** For each element containing at minimum a percentage value of 1 %, allocate the greenhouse gas emissions from the process to the metal based on value.
   As an example: In case the value of copper in the raw material input value is 80 % of the total value – then 80% of the greenhouse gas emissions should be allocated to copper.
   Metals are priced on London Metal Exchange (LME) or London bullion market association (precious metals, LBMA)

A.4 NO ALLOCATION AND SYSTEMS EXPANSION

If neither of the methods above is appropriate, it is allowed to have a conservative approach, thus to accredit all greenhouse gas emissions to the main product. It is also allowed with systems expansion and give credit for avoided environmental impact from avoided production.

It is also allowed with systems expansion with credit which is done for the production of sulfuric acid and energy, since they are not priced on a global market.

B APPLICATION OF ALLOCATION METHOD

The allocation of the greenhouse gas emissions to each metal is done in 3 steps:

1. Set the system boundary

2. Identify shared processes within the system boundary

   a) Identify process steps within the boundary of where greenhouse gas emissions can be allocated based on mass
   [As it is not pure commodities competing of the space in the processes, but rather raw material mixes, the allocation based on mass makes sense since the mass also defines the time as the process is used, which is the only way with current methods greenhouse gas emissions can be allocated. Therefore, a mass-based approach should be used for allocation between process steps and lines (boundaries).]

3. Identify co-products within each boundary

   a) Identify co-products within the boundary of where greenhouse gas emissions can be allocated based on mass
   b) Identify co-products of economic value to where greenhouse gas emissions shall be allocation based on market value

B.1 SET THE SYSTEM BOUNDARY

The system boundary should be defined based in the lines at the smelter.

The system boundary for gate to gate is defined based on the raw materials streams within the smelter. Each raw material stream forms a production line such as the copper line, the secondary copper line etc. The total amount of greenhouse gas emissions of the site has been calculated and reported in line with the organizational reporting, which is based upon the GHG protocol. The specific site; Rönnskär, are divided in 16 process steps. For each step it has been identified what raw material streams pass through the step. The allocation of greenhouse gas emissions is based on the mass feed of raw materials used by the process. For the allocation of emissions, the following formula has been used: Total amount of raw material feed in to produce metal X/Total amount of material feed in = the percentage of emissions that should be allocated to the production line.

Figure 1. Rönnskärs smelter Confidential

B.2 IDENTIFY SHARED PROCESSES WITHIN SYSTEM BOUNDARY

The identification of shared processes can easily be done by looking at the maps above and tick the boxes of which the line is using a certain process.

Table 1: Example matrix displaying which processes are used by which lines.

	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6
Process step 1	X	-	-	X	-	-
Process step 2	X	X	X	X	-	-
Process step 3	-	-	-	-	X	-
Process step 4	X	X	X	X	-	X
Process step 5	-	X	-	-	-	-
Process step 6	X	X	-	-	-	X
Process step 7	X	X	-	-	-	-
Process step 8	-	X	-	-	-	-
Process step 9	-	-	-	-	-	X
Process step 10	X	-	-	-	-	-
Process step 11	-	-	X	X	-	-
Process step 12	-	-	-	X	-	-
Process step 13	X	-	-	X	-	-
Process step 14	X	-	-	X	-	-

Identify process steps within the boundary of where greenhouse gas emissions can be allocated based on amount of time the process step is used for a certain line, if such data is available, otherwise the process step emissions should be allocated based on mass input to the line.

Feed percentage of the greenhouse gas emissions allocated to each line from each process in the table.

Keep records on which method for allocation is used, whether it is based on time used or mass.

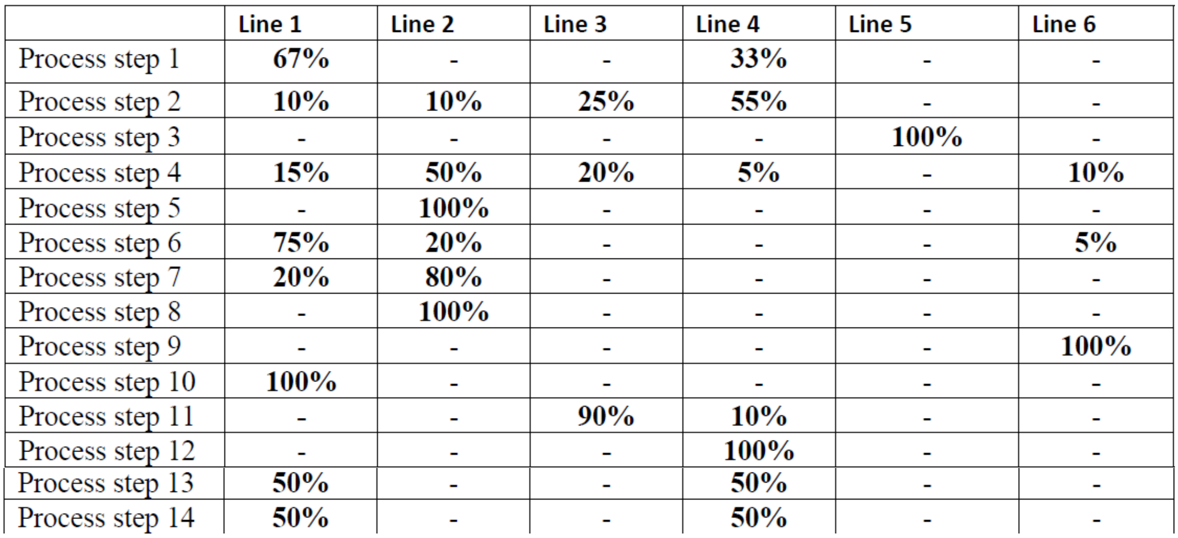
Example:

Looking at Table 1, the following processes are identified to be used by several lines:
Process step 1, Process step 2, Process step 4, Process step 6, Process step 7, Process step 11, Process step 13, Process step 14. The other processes is only relevant for that single line.

Suppose that time-use of each line is available for process step 2, 6, 7 and 14, then the amount [%] shall be fed into Table 2.

For the other processes in which time-data are missing, tonnage of raw material coming from each line shall define the allocation of greenhouse gas emissions from the process to each line. Suppose 100 000 tons of raw material goes in to process step 1 for the purpose of line 1 and 50 000 tons of raw material goes into process step 1 for the purpose of line 4. Then 67% is allocated to line 1 and 33 % is allocated to line 4. Do the same for all process steps.

Table 2: Allocated impact from each process to each line.



	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6
Process step 1	**67%**	-	-	**33%**	-	-
Process step 2	**10%**	**10%**	**25%**	**55%**	-	-
Process step 3	-	-	-	-	**100%**	-
Process step 4	**15%**	**50%**	**20%**	**5%**	-	**10%**
Process step 5	-	**100%**	-	-	-	-
Process step 6	**75%**	**20%**	-	-	-	**5%**
Process step 7	**20%**	**80%**	-	-	-	-
Process step 8	-	**100%**	-	-	-	-
Process step 9	-	-	-	-	-	**100%**
Process step 10	**100%**	-	-	-	-	-
Process step 11	-	-	**90%**	**10%**	-	-
Process step 12	-	-	-	**100%**	-	-
Process step 13	**50%**	-	-	**50%**	-	-
Process step 14	**50%**	-	-	**50%**	-	-

B3. IDENTIFY CO-PRODUCTS WITHIN EACH BOUNDARY

Each line represents a boundary, every boundary has inputs of raw materials and outputs of products and co-products.

Products are the main product from the line, and co-products are by products that may be produced within the same line (boundary).

The calculation shall first aim at deducting the greenhouse gas emissions that shall be allocated based on known data to products/co-products not priced on a global market.

a. The calculation shall first aim at deducting the greenhouse gas emissions that shall be allocated based on known data to products/co-products not priced on a global market.
b. Secondly, the remaining greenhouse gas emissions shall be allocated based on economic value [1]. The value allocation calculation looks as follows:

$$[\mathit{Tonnes\ of\ product\ sold\ from\ line}] \times [\mathit{Price\ per\ ton\ of\ product}] \, / \, \mathit{Total\ value\ sold\ from\ line} * ([\mathit{Tonnes\ CO2\ allocated\ to\ line}] - [\mathit{Tonnes\ CO2\ deducted\ from\ co\text{-}products\ not\ priced\ on\ global\ market}])$$

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[1] Metal prices used for Ni, Cu, Zn, Pb should be LME past 10 years annual average. Metal prices used for Ag, Au, Pd, Pt should be LBMA AM past 10 years annual average.

Example on the allocation calculation is presented in Table 3.

Table 3: Example – Line 1.

Products and Co-products	Volume sold	Price	Value $	CO2 allocation
1. Sek Cu	58 281	6 669 $/ton	388 666 679	**38%**
2. Au	276 180 tr.oz	1 270 $ / tr.oz	370 942 831	**36%**
3. Ag	11 577 530 tr.oz	21 $ / tr.oz	243 617 114	**24%**
4. Pd	11 574 tr.oz	807 $ / tr.oz	9 340 435	**1%**
5. Pt	14 789 tr.oz	1247 $ / tr.oz.	18 442 311	**2%**
	A	B	C	**D**

*C1 = A1*B1, D1 = C1/(C1+C2+C3+C4+C5). D is the amount of CO2 that will be allocated to that specific product.*

C. SUMMARY

After completing step B.1, B.2 & B.3, the greenhouse gas emissions for the different processes, products and co-products can be calculated. In order to understand how much greenhouse gas emission are emitted by each process, this must also be monitored and is a prerequisite for the final result.

D. CONSIDERATIONS

D.1 SUM OF EMISSIONS

- **What?** The total greenhouse gas emissions when summarizing all the emissions from each process step must be equal to the total greenhouse gas emissions reported on a monthly basis.
- **How?** Instead of summarizing the emissions in the end, the CO2 emissions from each process step should have a percentage of the total, so that the CO2 emissions can be calculated based on the total emissions already reported.

Example: *Total greenhouse gas emissions reported in smelter no 1: 100 000 ton.*
Number of process steps: 4
Process step 1: 35 900 tonnes, Process step 2: 590 tonnes, Process step 3: 55 900 tonnes, Process step 4: 11 200 tonnes. Sum of processes = 103 590 tonnes
*Process allocation: Step 1: 35 900/103 590= 34.66% → 34.66% * 100 000 = 34 660 tonnes.*
Do the same for the rest of the steps to get a correct value.

D2. METALS AND PRODUCTS

Only the sold amount of metals shall be accounted for when allocating the CO2 to products and co-products.

Pure metals

- Recycled Copper
- Primary Copper
- Primary Zinc
- Recycled Zinc
- Primary Lead
- Recycled Lead
- Au
- Ag
- Pd

Intermediates

- Nickel matte (Sum of Ni and Cu in the calculations below – but tonnage in the denominator)
- PGM concentrate (Sum of Pd and Pt – but total tonnage in denominator)
- Zinc clinker (Zink contained for allocation, but total tonnage in denominator)
- Ag concentrate (Ag contained for allocation, but total tonnage in denominator)
- Pt concentrate (Pt contained for allocation, but total tonnage in denominator)

By-products

- Sulphuric Acid
- Sold Iron Silicates

D3. MONITORING

The allocation calculation should be done every third year and if any larger change in production within the boundaries are implemented.

Appendix C: Data used in the pilot for copper wire rod production

SPECIFIC DATA FOR THE LCA STUDY PERFORMED FOR RÖNNSKÄRSVERKEN

Assumptions printed from the Excel file Rönnskär Confidential

RECYCLED CONTENT

Boliden copper cathode production at Rönnskärsverken

The value for the recycled content is based on the post-consumer scrap. The recycled content is 13%

CARBON FOOTPRINT

Boliden copper cathode production

Carbon footprint for primary copper is 996 kg CO2e/tonne and for secondary copper 1 293 kg CO2e/tonne[2].

Elektrokoppar copper wire rod production

Carbon footprint for copper wire rod production at Elektrokoppar is approximately 100 kg CO_2e/tonne but the exact number needs be verified with a third-party reviewed LCA study.

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[2] www.boliden.com

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