Catena-X Automotive Network

Catena-X Product Carbon Footprint Rulebook

CX-PCF Rules

Version 4

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Glossary

Term	Definition	Source
Allocation	Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems	ISO 14040
Attributable process	Those processes that consist of all service, material and energy flows that become, make and carry a product throughout its life cycle.	WBCSD Pathfinder
Biogenic carbon	Carbon derived from biomass	ISO 14050:2020(en) Environmental management — Vocabulary, 3.8.24
Carbon offsetting	Mechanism for compensating for a full PCF or a partial PCF through the prevention of the release of, reduction in, or removal of an amount of GHG emissions in a process outside the product system under study	ISO 14067, 3.1.1.7
Characterization factor	Factor derived from a characterization model, which is applied to convert an assigned life cycle inventory analysis (3.4.26) result to the common unit of the category indicator (3.10.8)	ISO 14050:2020, 3.6.23
Closed-loop recycling	In a closed loop, the secondary material from one product system is either reused in the same product system (real closed-loop) or used in another product system without changing the inherent technical properties of the material (quasi closed-loop).	ISO 5157:2023(en), 3.2.6.6
CO_2eq (carbon dioxide equivalent)	Unit for comparing the radiative forcing of a greenhouse gas to that of carbon dioxide	ISO 14050:2020(en) Environmental management — Vocabulary, 3.9.3.
Co-product	Any of two or more products coming from the same unit process or product system	DIN EN ISO 14067, Feb. 2019, p. 22
Cradle-to-gate	System boundary that is applied for a partial PCF assessment that includes a part of the product's life cycle. Cradle-to-gate represents the GHG emissions and removals arising from all life cycle stages, up to the point where the product leaves the production site (the "gate"). This explicitly excludes the life cycle stages use and end-of-life.	adapted from TFS PCF Guideline and in reference to ISO 14067 6.3.4.2 System boundary options
Cut-off criteria	Specification of the amount of material or energy flow or the level of significance of GHG emissions associated with unit process or the product system, to be excluded from a PCF study	DIN EN ISO 14067, Feb. 2019, p. 24
Date of issue	Time stamp at which the PCF has been declared, regardless of when it was shared. Date of issue represents the start of the validity period unless otherwise stated.	
Declared unit	Quantity of a product for use as a reference unit in the quantification of a Cradle-to-Gate PCF	adapted from DIN EN ISO 14067

Term	Definition	Source
Direct emissions	GHG emissions from the processes that are owned or controlled by the reporting company	WBCSD Pathfinder
Downstream emissions	Indirect GHG emissions that occur in the value chain following the processes owned or controlled by the reporting company	WBCSD Pathfinder
Functional unit	Quantified benefit of a product system for use as a comparison unit	
Global warming potential (GWP)	Index, based on radiative properties of GHGs, measuring the radiative forcing following a pulse emission of a unit mass of a given GHG in the present-day atmosphere integrated over a chosen time horizon, relative to that of carbon dioxide (CO_2)	DIN EN ISO 14067, Feb. 2019, p. 21
Greenhouse gases (GHGs)	Gaseous constituent of the atmosphere, both natural and anthropogenic, that absorbs and emits radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds	DIN EN ISO 14067, Feb. 2019, p. 19
ILCD Format	International Life Cycle Data System Format	
Input	Product, material, or energy flow that enters a unit process	WBCSD Pathfinder
Land use	Human use or management of land within the relevant boundary	DIN EN ISO 14067, Feb. 2019, p. 30
Life cycle	Consecutive and interlinked stages related to a product, from raw material acquisition or generation from natural resources to end-of-life treatment	DIN EN ISO 14067, Feb. 2019, p. 25
Life cycle assessment (LCA)	Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle	DIN EN ISO 14067, Feb. 2019, p. 25
Life cycle emissions	The sum of GHG emissions resulting from all stages of the life cycle of a product and within the specified boundaries of the product	WBCSD Pathfinder
Life cycle inventory (LCI)	The phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle (such as a product's GHG emissions and sources)	DIN EN ISO 14067, Feb. 2019, p. 25
Material	Physical goods that are further processed (and not consumed) in manufacturing processes.	adapted from WBCSD Pathfinder
Negative emissions	Removal of greenhouse gases (GHGs) from the atmosphere by deliberate human activities, i.e., in addition to the removal that would occur via natural carbon cycle processes	IPCC glossary
Net negative emissions	A situation of net negative emissions is achieved when, as the result of human activities, more greenhouse gases are removed from the atmosphere than are emitted into it. Where multiple greenhouse gases are involved, the quantification of negative emissions depends on the climate metric chosen to compare emissions of different gases (such as global warming potential, global temperature change	IPCC glossary

Term	Definition	Source
	potential, and others, as well as the chosen time horizon).	
Net zero CO_2 emissions	Net zero carbon dioxide (CO_2) emissions are achieved when anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals over a specified period. Net zero CO_2 emissions are also referred to as carbon neutrality.	IPCC glossary
Net zero emissions	Net zero emissions are achieved when anthropogenic emissions of greenhouse gases into the atmosphere are balanced by anthropogenic removals over a specified period. Where multiple greenhouse gases are involved, the quantification of net zero emissions depends on the climate metric chosen to compare emissions of different gases (such as global warming potential, global temperature change potential, and others, as well as the chosen time horizon).	IPCC glossary
Output	Product, material, or energy that leaves a unit process	WBCSD Pathfinder
Packaging	Any product to be used for the containment, protection, handling, delivery, storage, transport and presentation of goods, from raw materials to processed goods, from the producer to the user or consumer, including processor, assembler or other intermediary.	ISO 21067:2007(en)]
Paris Agreement	The Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) was adopted on December 2015 in Paris, France, at the 21st session of the Conference of the Parties (COP) to the UNFCCC. The agreement, adopted by 196 Parties to the UNFCCC, entered into force on November 4, 2016 and as of May 2018 had 195 Signatories and was ratified by 177 Parties. One of the goals of the Paris Agreement is “Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels”, recognizing that this would significantly reduce the risks and impacts of climate change.	IPCC Glossary
Partial PCF	Sum of GHG emissions and GHG removals of one or more selected process(es) in a product system, expressed as carbon dioxide equivalents and based on the selected stages or processes within the life cycle.	DIN EN ISO 14067, Feb. 2019, p. 16
PPA	Power purchase agreement On-site PPA: With an on-site power purchase agreement, a direct physical (and not just a balance sheet) supply of electricity takes place. Off-site PPA: Off-site PPAs do not involve a direct physical supply of electricity between the generator and a nearby consumer, but rather merely an agreement for the purchase of a physical amount of	

Term	Definition	Source
	electricity defined in the PPA. Unlike on-site PPAs, the generator delivers the electricity to the consumer via the public grid. Virtual or synthetic PPA: Synthetic PPAs decouple physical power flows from financial power flows, thus allowing for flexible contract designs. In virtual power purchase agreements, as with physical PPAs, producers and consumers agree on a price per kilowatt-hour of electricity. However, the electricity is not delivered directly from the energy-generator to the consumer. Instead, the producer's energy service provider (such as an electricity trader) includes the produced electricity in its balancing group and trades it further, for example, on the spot exchange.	
Primary data	Primary data is a quantified value of a process, or an activity obtained from a direct measurement or a calculation based on direct measurements. Primary data can include greenhouse gas emission factors and/or greenhouse gas activity data. Average data from industry associations or global averages do not qualify as primary data.	14067:2018, 3.1.6.1
Process	Set of interrelated or interacting activities that transforms inputs into outputs.	DIN EN ISO 14067, Feb. 2019, p. 23
Product	Any good (tangible product) or service (intangible product).	Adapted from WBCSD Pathfinder
Product carbon footprint (PCF)	Total GHG emissions generated during the life cycle of a product, measured in CO_2eq. Within the boundary of the CX-PCF Rulebook, emissions related to the product use and end-of-life stages are excluded from the PCF.	WBCSD Pathfinder
PCF system model	Mathematical representation of a physical system and the incorporated processes to calculate a PCF. Either complex, automated but also simple calculation solutions are referred to as PCF system models.	CX PCF Verification Guideline
Product category	Group of products that can fulfill equivalent functions.	WBCSD Pathfinder
Product category rules (PCR)	A set of specific rules, requirements, and guidelines for calculating PCFs (among other things) and developing environmental declarations for one or more product categories according to EN ISO 14040:2006.	WBCSD Pathfinder
Product system	Collection of unit processes with elementary and product flows, performing one or more defined functions, and which models the life cycle of a product	Adapted from ISO 14067: 2019
Prospective PCF	Product carbon footprint quantified for a production date in the future.	
Raw material	Primary or secondary material that is used to produce a semi-finished good, product or service.	Adapted ISO 14040/44

Term	Definition	Source
	Secondary material includes recycled material.	
Reference flow	Measure of the inputs to or outputs from processes in a given product system required to fulfil the function expressed by the functional unit.	DIN EN ISO 14067, Feb. 2019, p. 24
Reference period	The time period of primary data collection for a PCF. For a prospective PCF, the reference period refers to the period for which the PCF is reported and which includes the expected production date.	
Renewable Energy	Energy from renewable sources' or 'renewable energy' means energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas.	Renewable Energy Directive (2018/2001)
Representative product	The representative product can be a real or an averaged (non-existing) product. The averaged product should be calculated based on sales-weighted characteristics of all technologies/materials used in the company's production system.	
Residual mix	The mix of energy generation resources and associated attributes such as GHG emissions in a defined geographic boundary left after contractual instruments have been claimed/ retired/canceled. The residual mix can provide an emission factor for companies without contractual instruments to use in a market-based method calculation.	GHG Protocol Scope 2 Guidance, p106
Retrospective PCF	Product carbon footprint quantified for a production date in the past.	
Risk management	Plans, actions, strategies, or policies to reduce the likelihood and/or consequences of risks or to respond to consequences.	IPCC Glossary, p. 45
Secondary data	Secondary data can include data from databases and published literature, default emission factors from national inventories, calculated data estimates or other representative data, validated by competent authorities.	DIN EN ISO 14067, Feb. 2019, p. 28
Sectoral guideline	PCF reporting rules issued by industry associations or initiatives as guidance for their members,	
Supplier gate	The supplier's factory (out-bound) gate, through which the product leaves the production site and is ready for shipment to the customer.	
Supply chain	Those involved, through upstream and downstream linkages, in process and activities relating to the provision of products to the user.	DIN EN ISO 14067, Feb. 2019, p. 28
Sustainability	A dynamic process that guarantees the persistence of natural and human systems in an equitable manner.	IPCC Glossary, p. 49
System boundary	Boundary based on a set of criteria representing which unit processes are a part of the system under study.	DIN EN ISO 14040, Feb. 2021, p. 13

Term	Definition	Source
Transport / distribution packaging	Packaging designed to contain one or more articles or packages, or bulk material, for the purposes of transport, handling and/or distribution.	ISO 21067:2007(en)
Unit process	Smallest element considered in the life cycle inventory analysis for which input, and output data are quantified.	DIN EN ISO 14067, Feb. 2019, p. 23
Upstream emissions	Indirect GHG emissions that occur in the value chain prior to the processes owned or controlled by the reporting company. All upstream transportation emissions are also included as part of upstream emissions.	WBCSD Pathfinder
Use stage	That part of the life cycle of a product that occurs between the transfer of the product to the consumer and the end-of-life of the product.	Adapted from WBCSD Pathfinder
Validity period	Time period for which a PCF is declared as valid by the declarant. For the retrospective PCF the validity period must at least include the reference period.	
Value chain	All the upstream and downstream activities associated with the product system.	
Waste	Materials, co-products, products, or emissions without economic value that the holder intends or is required to dispose of.	DIN EN ISO 14067, Feb. 2019, p. 26; WBCSD Pathfinder

Key Changes

Topic, chapter	Rulebook v3.1	Rulebook v4
Transition period extended to 2027 (Chapter 2, p. 16)	Transition Period end: End of 2025	Transition Period end: End of 2027 extended to enable the applicability of the PCF Rulebook especially for SMEs in the short term and to give them time to get adapted to the demanding additional rules
PCF total incl. biogenic carbon uptake mandatory (Chapter 4, p. 18 ff.)	Optional, mandatory after transition period	Mandatory and lead indicator for PCF, PDS, DQR and verification share to align with other initiatives (PACT, TFS)
Screening analysis / recalculation of PCF (Chapter 4.3.1, p. 21 f.)	Recalculating needed if the screening analysis shows a 5 percent increase.	Recalculating needed if the screening analysis shows a 10 percent increase. The cut-off criteria was increased from one percent to three percent of the total PCF in version 3. In order not to be too close to this three percent, the limit for a recalculation of the PCF was increased from 5% to 10% in version 4 of the Rulebook
Rules for prospective PCF added (Chapter 5.2.1, p. 24 f.)	--	Added to ensure a standardized calculation of PCFs of prospective products
Infrastructure emissions included for electricity generation (Chapter 5.2.6, p. 32 ff.)	Infrastructure emissions excluded for all cases	Infrastructure included for electricity generation because of the significant influence of infrastructure emissions in case of renewable electricity generation
Clear rules for Chain of Custody approaches (Chapter 5.2.7, p. 34 ff.)	Descriptive character without clear guidelines	Clear guideline and rules especially for the mass balance credit method
Update of Annexes A 3 to A 6 (sector-specific requirements) to reflect changes in CX PCF Rulebook v4 (Annexes, p. 48 ff.)	Annexes A 3 to A 6 provide additional requirements and recommendations for the steel, chemicals and aluminum sectors to be CX-PCF compliant.	The tables were updated to reflect the recent changes on temporal validity and chain of custody

1. Introduction

1.1 The automotive industry and the climate crisis

The automotive industry is a customer-facing industry with high visibility at the cutting-edge of climate action and is a solution provider in the current climate crisis driving the transition towards low-emission mobility. Nevertheless, the global challenge to reduce GHG emissions also requires the automotive industry to measure its GHG emissions on the product level for the status-quo as well as any emissions reductions. Measuring the product carbon footprint for vehicles is a challenge, due to the enormous complexity of the international automotive supply chain. A vast number of materials and parts are used for vehicles. Even identical materials and parts are usually produced by different companies in different locations to ensure supply chain resilience and risk management.

1.2 The challenge

For many years, the automotive industry and suppliers have applied well-established methods to calculate the product carbon footprint (PCF) and report the results in line with international standards such as the ISO 14040, 14044 and 14067 standards or the GHG Protocol Product Standard.

For today's portfolio of combustion engine-powered vehicles running on fossil fuel, 70 – 90% of the product carbon footprint is caused by the use stage and 10 - 30% from the production stage, including the supply chain (see also ACEA 2021[1] p. 3). The state of the art in product carbon footprinting has been considered sufficient in addressing the trade-offs between efforts and benefits. However, the latest and future powertrain technologies and fuel pathways aim to reduce the overall GHG emissions of vehicles. This can shift the contribution from the use to the production stage. Especially for battery electric vehicles toward 50% of emissions can stem from early production stages (see also ACEA 2021[1] p. 3). Hence, the majority of GHG emissions in the life cycle of vehicles will occur during the production stage and will require a more precise quantification compared to the current state of the art.

Product carbon footprint and life cycle assessment standards and methods exist in the ISO 14040, 14044 and ISO 14067 standards as well as the GHG Protocol Product Standard, the WBCSD Pathfinder Framework and sector-specific guidelines such as Product Category Rules. However, these standards and methods are not sufficiently prescriptive and thus leave room for interpretation. Therefore, companies are not consistently applying these standards and methods. Consequently, product carbon footprints reported from different companies do not follow one consistent approach and comparability is limited. In addition, the current application of well-established methods is mostly based on industry average data. Hence, the current practice of calculating PCFs are not specific to a supply chain and deviations between different supply chains remain unrecognized.

For the automotive industry, this constitutes a major obstacle to assess emissions reduction goals. Hence, the automotive industry is in great need of consistent product-specific GHG emissions reporting with comparability across the industry.

This awareness of this need for a higher level of accuracy and consistency is shared by several sector initiatives, which have sector-specific product carbon footprint accounting rules which have been published, are under development or are being planned. Those initiatives, however, do not always bring the level of consistency required in the automotive sector, nor the cross-industry comparability which is necessary for reliable and comparable figures at the supply chain level. Combined with increasing product-level regulatory requirements, such as the EU Battery Regulation, stronger integration of those initiatives is needed.

The automotive industry is ideally positioned to lead this cross-industry supply chain dialogue given its reach across sectors, the quantities of materials supplied and its focus on high-quality materials, in many instances due to safety requirements. By exchanging comparable and verified product carbon footprints based on product-level primary GHG emissions data, automotive companies will be able to identify, improve and accelerate decarbonization efforts in their supply chains and in particular hard-to-abate sectors, playing their part in ensuring there is a real chance of meeting the Paris Agreement targets.

In the past, the range of variation in PCF-reporting during production did not lead to significant distortions over the entire life cycle due to the high contribution of the use stage.

[1] https://www.acea.auto/files/ACEA_position_paper-Life_Cycle_Assessment.pdf

Supplier-specific GHG emissions based on an increasing share of primary data can be obtained by accounting and reporting at the product level for each company in the supply chain, i.e., each tier. The Catena-X network's eco-system enables data-driven value chains, which will allow companies to efficiently exchange data by maintaining full data sovereignty, which ensures that any sensitive information will be hosted within the respective company.

However, the problem of insufficiently prescriptive standards remains and, thus, reported PCFs may differ significantly between companies, even though identical parts with identical processes have been applied. These differences would not come from factual differences but are related to differing interpretations of PCF standards. Due to the climate goals of companies, product carbon footprints will become a critical KPI in the purchase of parts and materials and, thus, PCFs need to provide a robust basis for decision-making, i.e., differences in PCFs should only be caused by factually deviating emissions. Consequently, a more detailed view of the accounting methods for PCFs in the automotive supply chain is necessary for exchanging PCFs via the Catena-X network.

An additional challenge arises if a PCF is requested for a production date that lies in the future. This may occur because a product is still in development or, if already in production, the change of PCF over time until a future production date is desired.

Providing carbon footprint information ahead of the actual production date is challenging due to the high number of required assumptions e.g. on supply chain, transport distance, production planning etc. Therefore, the PCF data model must allow to clearly differentiate between a prospective and retrospective PCF.

As a prospective PCF may be exchanged during a procurement process, questions of comparability and dependability of prospective PCFs for procurement decisions can arise. The rules for a prospective PCF defined in this document cannot eliminate the uncertainty that is inherent to a prognosis. Any prognosis or scenario for the future comes in the variation from conservative to optimistic.

The rationale to establish rules for a prospective PCF lies in defining a baseline scenario that evaluates the possible changes to a PCF as soberly as possible and whose permissible assumptions are agreed to all recipients of the PCF. The 'baseline prospective PCF' that follows these rules should therefore be largely free from the reporting party's subjective assessment and thus allow a high degree of comparability.

On the other hand, one could also want to show the best possible PCF achievable, i.e. a 'progressive prospective PCF'. It is up to the reporting party to decide about viable reduction measures to be considered and about the associated risks and uncertainties. Consequently, there are no meaningful rules for evaluating such 'progressive prospective PCF' and it is therefore out of scope for reporting within Catena-X.

The Catena-X PCF use case focuses on standardization, verification and communication of PCFs. This scope does not include the procurement or target setting/agreement process itself.

1.3 The purpose of this document

To reduce the room for interpretation of the standards, Catena-X developed this Product Carbon Footprint Rulebook with a focus on the exchange of production carbon footprints from tier to tier. The concept is illustrated in Figure 1 with a simplified supply chain. Each Tier (n) is quantifying emissions from their own operations (gate to gate) with increased consistency and adding the upstream emissions from their respective Tiers (n+1) to report the PCF to the next Tier in line (n-1). This increased consistency for PCF accounting will ensure comparability for the (cradle to gate) PCFs of parts and components and allow for part and supplier selection. Consequently, the Catena-X Rulebook focusses on the production stage of vehicles.

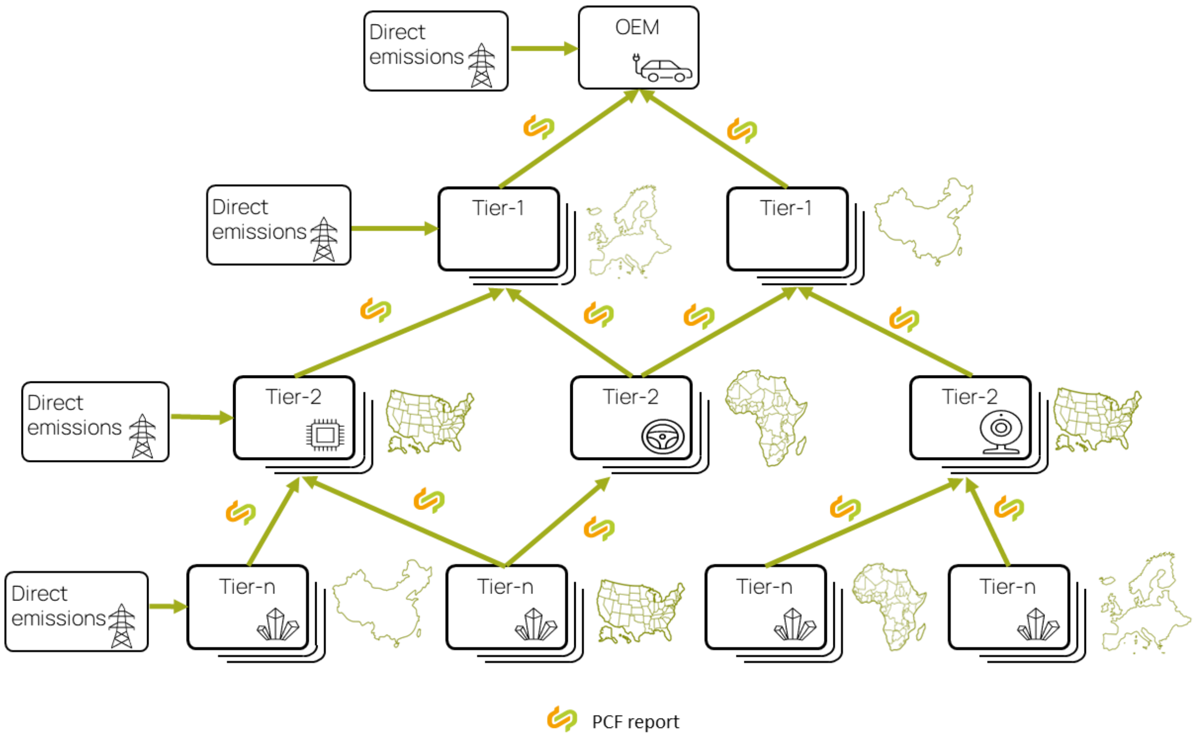


Figure 1: Reporting PCF along a supply chain

At the same time, accounting for product carbon footprints is mostly applied in large companies, whereas smaller companies may lack the resources or the knowledge to account for the emissions of their products. Hence, this rulebook needs to carefully balance applicability and comparability of product carbon footprint accounting to ensure the rules are scalable along the entire supply chain. For this purpose, the Catena-X Rulebook foresees the application of some rules after a transition period in order to allow companies to adopt more complex rules. Additionally, guidance materials will be developed and cooperation with stakeholders representing small-to-medium-sized enterprises will be strengthened in the near future.

As data sovereignty prohibits the full disclosure of the information required for PCF accounting, the Catena-X PCF Rulebook defines indicators for data quality and the amount of primary data used for PCF accounting

Catena-X makes its PCF Rulebook available to the public and is open for any feedback to ensure public acceptance of the reported PCFs within the Catena-X ecosystem.

This document is not intended to guarantee the conformity of any reporting to Corporate Scope 3 Accounting (GHG protocol).

The Catena-X PCF Rulebook provides rules to quantify PCFs prospective and retrospective from the actual production date or period. Unless specifically indicated, the provisions of the rulebook apply to both cases.

Even though it is crucial to differentiate between prospective and retrospective PCF, it is important to note that the fundamental calculation rules (system boundaries, allocation, cut-off …) remain the same.

The Catena-X PCF Rulebook defines the rules for quantification of product carbon footprints; it does **not** deal with the verification of calculation result. The Catena-X & TfS PCF Verification and PCF Program Certification Framework in the latest version provides rules and guidance for the PCF Verification and is also made publicly available.

The automotive supply chain has enormous complexity, using materials produced by various industry sectors including steel making, chemical production, electrical parts and computer chips. Therefore, the Catena-X PCF Rulebook allows for the application of existing or new sectoral guidance and product category rules if recommended or accepted by Catena-X. With sectors specifically relevant for the automotive supply chain Catena-X is engaging to seek alignment to accept these initiatives' or associations' PCF methodology guidelines or standards fully or with selected additional requirements to be used for calculating PCFs and reporting them into and via the Catena-X ecosystem. The currently prioritized sector methodologies are described in Annex A 2. Further the Annexes A 3 – 0 provide the current status of acceptance, additional requirements and recommendations for each sector methodology. Newly published versions of these sectoral methodologies may require updates of the respective additional requirements and recommendations by Catena-X and will be considered and updated as soon as the next version of the Catena-X PCF rulebook is prepared. Furthermore Catena-X establishes a governance process and criteria for sector guidance acceptance through Catena-X that further sector methodologies can use to seek acceptance. If an overall acceptance of a PCF sector-guidance as a drop-in standard for Catena-X is reached, this sector-specific guidance shall apply to the respective sector.

In addition, Catena-X is in ongoing alignment with other ecosystems to ensure interoperability through aligned PCF data exchange models, such as the industry-agnostic Pathfinder Initiative by WBCSD (PACT).

In May 2024 the European Commission has published a draft of the *ANNEX to the Commission Delegated Regulation supplementing Regulation (EU) 2023/1542 of the European Parliament and of the Council by establishing the methodology for the calculation and verification of the carbon footprint of electric vehicle batteries*, which will become, once the final delegated regulation is published, the mandated methodology for electric vehicle batteries in the European Union to be used for PCFs reported in Battery Passport. In the current version of the Catena-X PCF rulebook no specific guidance on electric vehicle batteries are referenced due to the still draft status of the regulation. A delta analysis is published by Catena-X to clarify divergences and leverage synergies between the CX-PCF Rulebook and the delegated regulation on electric vehicle batteries.

To improve the applicability of the PCF Rulebook, Catena-X has published various guidance documents.

1.4 Catena-X PCF Use-Case Framework

Exchanging PCFs based on the Catena-X Product Carbon Footprint Rulebook requires a predefined use case framework (Product Carbon Footprint ("PCF"))[2] for each participant. They must agree to this Framework and make their data exchange legally binding by way of separate declarations. To comply with this use-case framework: "Data Provider and Data Consumer are responsible for compliance with all legal and regulatory requirements applicable (in particular with regard to (i) antitrust law (including, but not limited to, antitrust-compliant implementation taking into account the "one-up-one-down principle" and "compliance by design"), (ii) tax, trade and export control law, (iii) data protection, (iv) trade secrets, digital regulation) for themselves and any Affiliates registered for this Use Case".

[2]https://catena-x.academy/librarian/?gv_search=PCF&mode=any

2. Setup of the framework

2.1 Version

This is version 4 of the Catena-X Product Carbon Footprint Rulebook released in September 2025. This rulebook will be updated and PCFs shall thus be calculated according to the latest available version of this rulebook.

2.2 Terminology: Shall, should, may, can

Clarification on ISO expressions used in the rulebook:

The following definitions apply in understanding how to implement an ISO International Standard and other normative ISO deliverables:

- The term "shall" indicate what is required for a CX-PCF to be compliant with this rulebook.
- The term "should" indicate a recommendation rather than a requirement. Any deviation from a "should" recommendation must be justified by the party conducting the study and made transparent.
- The term "may" indicate an option that is permissible.
- The term "can" is used to indicate that something is possible, for example, that an organization or individual is able to do something.

Additional definitions of frequently used terms throughout the rulebook can be found in the Glossary (see page A).

2.3 Topics out of scope

The Catena-X Rulebook focusses on the production of vehicles and, thus, PCF accounting spans from cradle-to-(factory outbound)gate for vehicles and components and all intermediate products. Therefore, recycling is currently only reflected in the PCF through the use of secondary material. To holistically account for recycling and assess recycling strategies, other methods are required, but currently out of scope.

2.4 Transition period

This document foresees a transition period after the official start of the Catena-X PCF automotive network. Sections marked as "after the transition period" are voluntary within the transition period. After the transition period, these sections are planned to be substituted by the section marked as "within transition period" and will thus become mandatory. The transition period will last until end of 2027.

3. Existing methods and standards

3.1 Relationship

The Catena-X Product Carbon Footprint Rulebook (CX-PCF Rulebook) is based on the product carbon footprint standard ISO 14067 and the ISO 14040 and 14044 life cycle assessment standards (Figure 2).

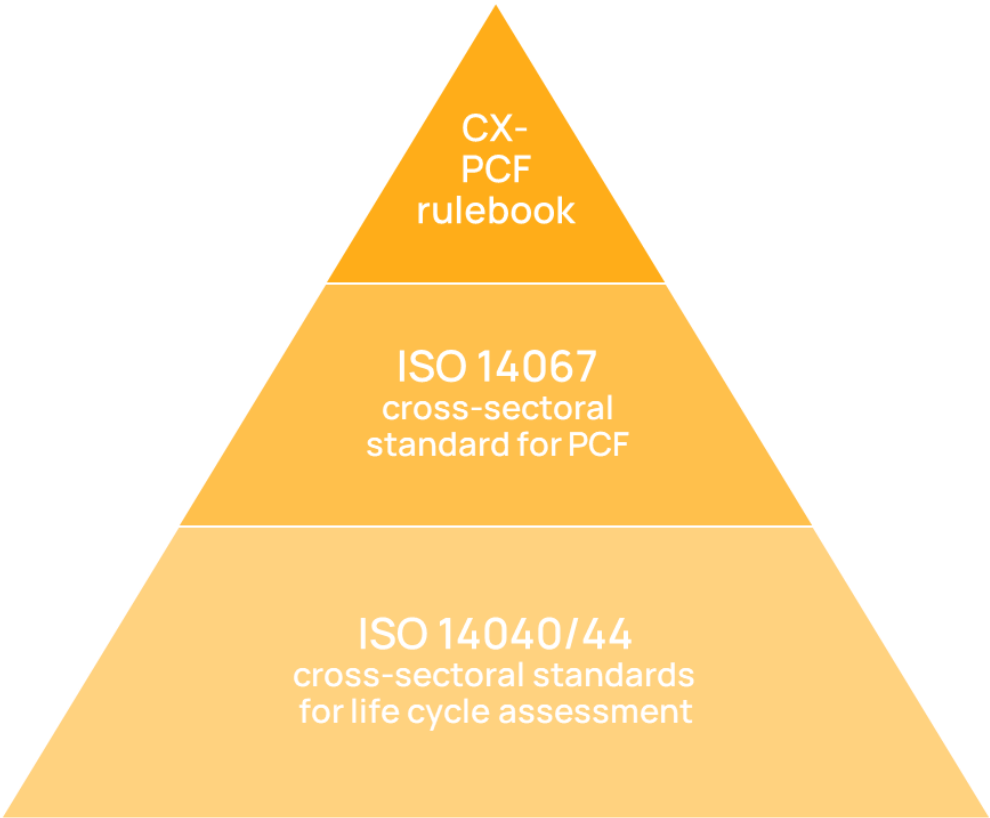


Figure 2: Relationship of standards

The CX-PCF Rulebook further specify existing standards and, if applicable, refer to sectoral guidance and product category rules for product carbon footprints in automotive supply chains.

The CX-PCF Rulebook is closely aligned with the WBCSD Pathfinder Framework. Further alignment with sector initiatives such as Together for Sustainability (TFS), worldsteel, International Aluminum and European Aluminum has taken place. As a result, these standards can be used as a drop-in standard with the additional requirements described in Annex 2.

Additional alignment processes for other sectoral guidance are planned.

3.2 Hierarchy of conformity

Existing rules shall be applied according to the following hierarchy:

1. The product carbon footprints shall be calculated in accordance with ISO 14067.
2. Automotive supply chain-specific requirements shall be applied as defined in this document.
3. Sector-specific and product-specific rules should be applied if prescribed within this rulebook.

Eventually, additional sector-specific or product-specific guidance will be added.

Information on the applied methods or standards shall be shared downstream as part of the PCF Data Model (Section 7.1) to create greater transparency and enable comparability.

4. Scope and system boundary

The CX-PCF rules are based on the attributional LCA approach. This approach seeks to determine the environmental impacts associated with a product's life cycle. The global warming potential (GWP), expressed in CO_2 equivalents, is attributed to a specific unit of a product by adding up the CO_2 equivalents of all attributable processes along its life cycle.

4.1 Quantification of carbon footprint (biogenic and/or fossil)

The CX-PCF Rulebook provides the methodological framework for assessing the product carbon footprint.

The GHGs that shall be accounted for are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorinated compounds, sulfur hexafluoride (SF_6), nitrogen trifluoride (NF_3), perfluorocarbons (PFCs), hydrofluoroethers (HFEs), perfluoropolyethers (e.g., PFPEs), chlorofluorocarbon (CFCs) and hydrochlorofluorocarbon (HCFCs). To ensure the latest required GHGs, please refer to IPCC AR.

The 100-year GWP characterization factors (GWP100y) according to the Intergovernmental Panel on Climate Change (IPCC) shall be used in the PCF calculations, based on the latest IPCC's Assessment Report (AR). These factors include the climate carbon response for non-CO_2 gases, i.e., carbon feedbacks and chemical effects.

Once a new AR has been published, its characterization factors shall be used. If the characterization factors cannot be updated immediately, a transition period of two years after the publication of a new IPCC AR is granted after which the characterization factors shall be updated. If secondary data used are based on outdated characterization factors, this must be clearly stated and alternative datasets that use the latest characterization factors should be prioritised.

Currently applicable during AR6 being the latest AR: The AR 6 characterization factors for the substances that are not listed in case of AR 6 in Table 7.15 of the IPCC AR6[3] shall be extracted from Table 7 SM6 in Section 7 Supplementary Materials of the AR6 Climate Change 2021[4].

Currently different GHG accounting schemes, i.e., PCF including (ISO 14067) and excluding biogenic CO_2 (PEF and GHG protocol), are applied. The situation is depicted in Figure 3 with the individual contributions (referred to as position A-H) to the total PCF explained in Table 1.

For PCF reporting according to the Catena-X Rulebook, both the total GWP including biogenic CO_2 uptake (T1 in Table 1) and the total GWP excluding biogenic CO_2 uptake (T2 in Table 1) shall be provided. The total GWP including biogenic CO_2 uptake shall be used for the calculation of the primary data share, the data quality rating and the verification share.

The total GWP including biogenic CO_2 uptake includes the sum of the separate emission values T1 = A+C+D+E+F+G+H[5] and the PCF excluding biogenic CO_2 uptake includes the sum of the separate emission values T2 = A+C+E+F+G+H.

In addition to the total PCF, following emission values should be reported separately:

Table 1: Explanation of the factors influencing the biogenic uptake

Emission	Conditional	Description
GWP total incl. biogenic CO_2 Uptake	Shall	Position T1= = A+C+D(negative contribution)+E+F+G(negative contribution)+H. Letters refer to individual emission categories below. This also refers to the -1/+1 Approach. "GWP total inc. bio. uptake" may be set equal to "GWP total excl. bio. uptake" if the product has no or a neglectable biogenic carbon content. General cut-off criteria apply as criteria for negligibility.

[3] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07.pdf
[4] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf

GWP total excl. biogenic uptake	Shall	Position T2= = A+B+C+E+F+G(negative contribution)+H. Letters refer to individual emission categories below. This is also refers to the 0/0 Approach.
GWP fossil	Should	Position A: includes all fossil emissions, including industrial processes, stationary/mobile combustion and fugitive emissions. This position includes the fossil emissions associated to land management (A1: "GWP fossil land management") which cannot be documented as a separate emission category in the Catena-X data set, but is part of PACT and TFS
GWP biogenic emissions other than CO_2	Should	Position C: non-CO_2 biogenic emissions related to agricultural activities. It encompasses emissions as described in PACT v3.0: CH_4 emissions from livestock and manure; CH_4 emissions from biomass burning and fires; CH_4 emissions from rice production; CH_4 emissions from transformation and degradation (e.g., combustion, digestion, composting, landfilling). It must be noted that N_2O from land management activities are not included in this position and are reported in position A and A1 (as a detail).
GWP biogenic CO_2-uptake (biogenic CO_2 contained in the product)	Should	Position D (negative contribution): The CO_2 which was absorbed from the atmosphere during the growth period of the biomass and of which the C is now bound in the product as biogenic carbon content.
GWP land use change (LUC, excluding iLUC)	Should	Position E: Emissions from LUC constitute a release of GHG emissions due to a change in land use from one land use category or subcategory to another, such as primary forest to agricultural land, or peat land (type of wetland) to cropland. This position encompasses dLUC (direct land use change) emissions. If that data is not available, companies should account for LUC using statistical land-use change (sLUC) emissions. iLUC emissions are excluded. Refer to PACT v3.0 for details.
GWP Land Management CO_2 Emissions	Should	Position F: carbon stock losses occurring within the same land use category or subcategory due to agricultural practices such as tillage, field preparations, pruning and harvest. Land Management CO_2 emissions measures biogenic CO_2 emissions from a net loss in carbon stock within one land use category or subcategory. This includes impact on the land-carbon pools, including above- and below-ground biomass, dead organic matter, and soil carbon pools. If the carbon stock increases within the same land use category and the conditions to report removals are met, this may be calculated as a Land management CO_2 removal (position G). Refer to PACT v3.0 for details.
GWP Land Management CO_2 Removals	Should	Position G (negative contribution): Land management removals are net CO_2 removals resulting from net increases to carbon stored in land-based carbon pools (biomass, dead organic matter and soil carbon pools) due to ongoing land management practices. This extra net carbon stock is gained over the crop rotation or crop cultivation cycle (e.g., multiple years for perennial crops and multiple years in a rotation that includes annual crops). Refer to PACT v3.0 for details.
GWP Aviation emissions (upstream)	Should	Position H: Aviation emissions which have occurred in distribution stages upstream.

If separate emission values do not occur, these emission values may be reported as zero.

Removals in the PCF shall not include any measures not related to the production system usually referred to as carbon offsets (see Section 7.2.6).

In addition, the biogenic carbon content and total carbon content of products should be reported separately.

Uptake of atmospheric CO_2 shall be assigned with a characterization factor of -1 kg CO_2eq per kg CO_2; the emission of CO_2 shall be assigned with a factor of 1 kg CO_2eq per kg CO_2. If plants absorb atmospheric CO_2, the CO_2 is shall be considered in the separate emission value D (GWP biogenic CO_2-uptake) if documented.

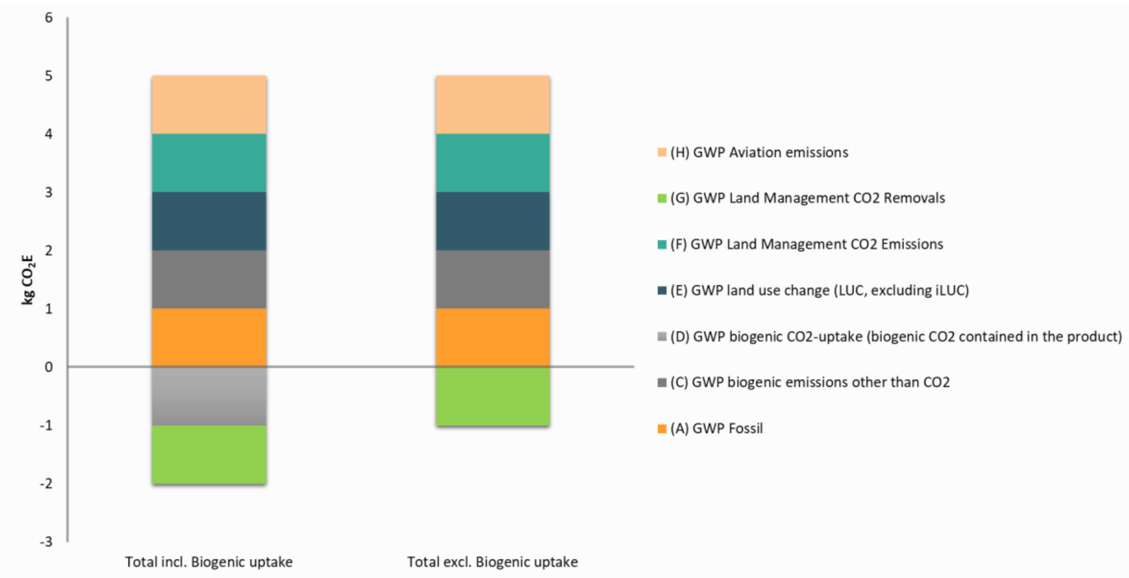


Figure 3: Overview of the specific components of the PCF including and excluding biogenic uptake

4.2 System boundaries

In general, the life cycle of a product comprises five stages: (1) resource extraction, raw material sourcing, (2) production, (3) distribution and storage, (4) product use and (5) end-of-life (Figure 4). The CX-PCF scope represents a reduced subset of these stages, excluding product use and end-of-life. This partial PCF, exchanged by a company (supplier), can then be used to calculate the PCF, e.g., of a vehicle over the complete life cycle by the customer, selling a product to the end customer (e.g., OEM). Despite the fact that the end-of-life (EoL) stage is excluded from the scope of this document the PCF-rules described in this document are applicable to the EoL processes as well and specifically shall be applied to quantify the carbon footprint of secondary material or reuse/remanufacturing of components.

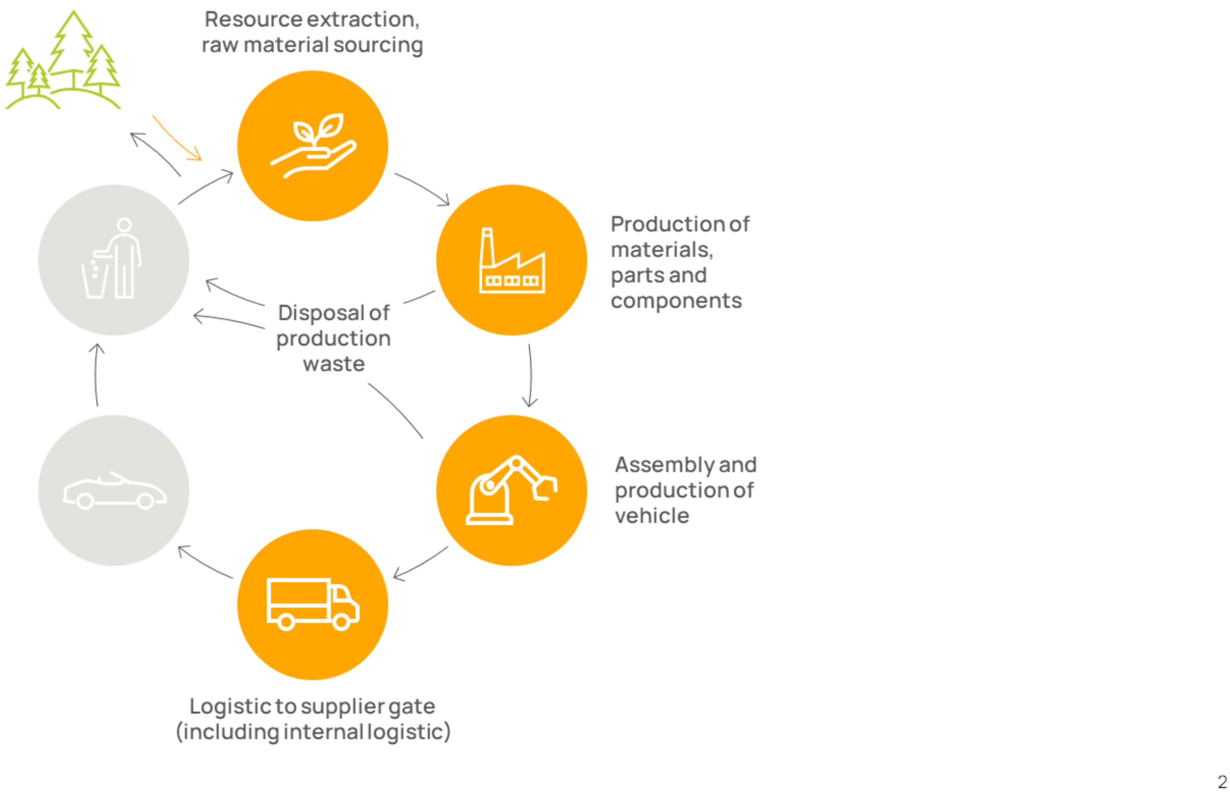


Figure 4: System boundaries for Catena-X PCF

The cradle-to gate PCF of the CX-PCF Rulebook includes all attributable upstream and direct emissions of producing a product, including all upstream transportation activities. The life cycle emissions that shall be accounted for in this cradle-to-gate PCF exclude downstream emissions related to the product use and end-of-life stages.

When accounting for emissions, companies shall further define their cradle-to-gate boundary by listing all the attributable processes of their studied product.

The CX-PCF rules system boundaries are therefore:

- Resource extraction, raw material sourcing
- Production of materials, semi-finished products
- Production of vehicle parts and components
- Packaging of vehicle parts and components, including all operations required for performing packaging
- Disposal of production waste (incl. packaging waste)

Logistics (including internal logistics and transport packaging) (Section 5.2.3)

- Quality control in production
- IT for process and manufacturing control

Despite of being included in the system boundaries in principle, insignificant processes may be excluded based on the cut-off rules outlined in section 4.3.

In general, GHG emissions not connected directly to the production system relevant for the product shall be excluded from the system boundaries. These are amongst others:

- Employee commuting and work travel
- Research and development, administration, or sales processes
- Auxiliary inputs not directly related to the production process (such as heating and lighting of associated office rooms, secondary services like maintenance, sanitary facilities, canteen services, facility management e.g., plant security and fire safety and general IT)
- Auxiliary inputs to maintain the manufacturing equipment
- Emissions from construction or dismantling of capital good (such as buildings, manufacturing equipment or any other infrastructure for transport, and media distribution, within or outside the control of the reporting company)

4.3 Cut-off rules - Criteria to exclude certain activities

In general, all processes and flows that are attributable to the analyzed system shall be included. If, based on the results of a screening analyses, individual material or energy flows are found to be insignificant for the carbon footprint, these may be excluded for practical reasons (see ISO 14067, PEF method). Process modules, inputs and outputs may only be excluded if their sum represents less than 3% of the total product carbon footprint. This 97% coverage shall be achieved and documented in a screening analysis.

4.3.1 Screening Analysis

An initial screening of the Life Cycle Inventory (LCI) of (a) representative product(s) shall be performed by the company calculating PCFs, referred to as the screening step. The screening pursues the goal to point out needs of action in terms of data collection activities or activities to improve data quality. A screening shall include the Life Cycle Impact Assessment (LCIA) for the Impact Category climate change using the characterization factor Global Warming Potential and allow further refinement of the PCF system model of the product(s) in scope in an iterative manner as more information becomes available. Within screening, no exemption is allowed, and readily available primary or secondary data may be used, fulfilling the data quality requirements to the extent possible.

To determine the 97% coverage, the PCF data received from suppliers and emission factors shall be considered as 100%, as direct insights in the actual coverage of the upstream supply chain are impossible.

Once the screening is performed, the initial scope settings may be refined. The representative product approach and a description of the excluded attributable processes shall be documented.

The screening analysis shall be updated at the end of the validity period of the CX-PCF (see section 7.2.1), so that possible changes of significant activities can be considered.

Compliance can be proven on a product category or sectoral level and does not have to be executed on a product level. Product category rules or sectoral guidance can specify simplified rules that can be applied after the Catena-X sectoral guidance acceptance process.

The results of the screening analysis shall be documented.

4.4 Declared unit

The product carbon footprint shall be assessed for a declared unit. A functional equivalent is established by the data recipient and lies beyond the scope of the Catena-X PCF Rulebook.

Possible declared units are piece, kilogram, liter, cubic meter, kilowatt hour, megajoule, ton kilometer, square meter, hour and megabit second.

For countable products, i.e., a component or part, the declared unit should be 1 piece as described in the part description including a defined weight and the part ID.

For materials, i.e., mass products or commodities, the declared unit should be 1 kg of products, regardless of its state (solid, liquid, gas), as its specific density is considered.

If packaging is included, the declared unit should be 1 kg or 1 piece of unpackaged product at the factory gate. The PCF however includes the PCF contribution of packaging.

5. Guidance for product carbon footprinting

5.1 Accounting for product carbon footprint

System boundaries shall include all attributable processes that comply with the cut-off criteria (see section 4.3)

5.1.1 Calculation

Included in the supplementary Guidance Product Carbon Footprint (PCF) Calculation.

5.1.2 Allocation

Allocation shall be avoided whenever possible. If allocation cannot be avoided, follow the approach in Figure 5. In all cases, double counting shall be avoided by applying consistent allocation approaches.

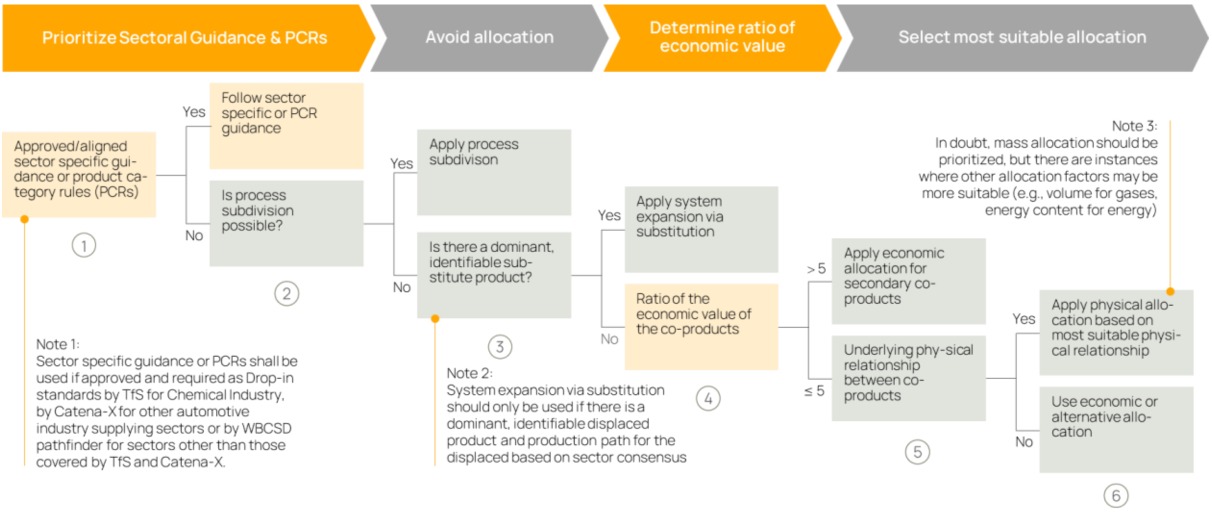


Figure 5: Multi-output allocation decision procedure

1 If sector-specific guidance or a PCR exists, a legal entity producing a product belonging to a category in this sector shall follow this guidance or PCR to identify the adequate multi-output allocation approach. The prerequisite for the application of the sector-specific or PCR is an alignment and acceptance via the Catena-X governance process or an initiative representing an industry sector and authoring a sector guidance which is accepted by Catena-X as drop-in standard. Any remaining differences or contradictions to the Catena-X Rulebook in an accepted sector guidance or PCR will be handled via the governance process and, if required, additional guidance will be provided.

2 If no approved or aligned sectoral guidance or PCR is available and subdivision is possible, subdivision shall be applied. Subdivision refers to disaggregation of multifunctional processes or facilities to isolate the input flows directly associated with each process or facility output.

3 If subdivision cannot be applied, but a dominant substitute product can be identified, expanding the product system to include the additional functions related to the co-products shall be applied. System expansion via substitution shall only be used in accordance with the following conditions, also reflected in Note 2. in Figure 5:

System expansion via substitution should only be used if there is a dominant, identifiable displaced product and production path for the displaced product based on sector consensus. Dominant means that the production process is the main process on the market. If available, positive lists of co-products and displaced products based on sector consensus shall be used to model the system expansion and the respective substitution credits. For the emissions data, primary data shall be used and secondary data may only be used if primary data is not available. In case of secondary data, the requirements in section 6 shall apply to guarantee that the dataset and source for calculating system expansion credits are compliant. If no sector consensus exists, the following requirements shall always be fulfilled:

- The production of the co-product is an integral part of the production process
- A dedicated, single-output process to produce the co-product exists
- The alternative dataset must be representative of the dominant production route and comply with the requirements of chapter 6.2
- A clear description of the process for selecting the alternative product substituted by the co-product shall be internally documented

No market-mediated effects shall be applied, as the attributional LCA approach shall be used. The customer of the co-product can be provided with a PCF of the co-product. This enables the customer of the co-product to account for the co-product's correct footprint and prevents double counting of credits.

4 When allocation cannot be avoided, no subdivision is possible and no dominant substitute product can be identified, companies shall calculate the ratio of the economic value of the reference product to each co-product per declared unit. This ratio is employed in the next step of the decision tree to determine the most suitable allocation approach. For the use of economic values, prices as shown in the hierarchy below shall be averaged over the last 3-5 years to smooth out fluctuations.

5 If the calculated economic value ratio is equal or lower than five, companies shall apply allocation using a physical relationship to partition inputs and outputs between the studied co-product(s). The physical relationships to choose from are:

- produced masses
- produced pieces
- contained exergy
- contained energy

Combined electricity and heat generation represents a special allocation problem. In this case, allocation shall be based on the amount of exergy generated.

6 If the calculated ratio is higher than five, companies shall apply an economic allocation using economic value as criterion to partition inputs and outputs between the studied co-product(s).

For the determination and use of economic allocation factors, the following hierarchy shall be applied. Only one type of economic allocation factor shall be chosen consistently in the order of priority of the hierarchy. Only if the respective prioritized factor is not available, the next factor in the hierarchy may be chosen. The chosen factor shall always be averaged over 3-5 years to smooth out fluctuations. A systematic approach should be internally documented for materials with high fluctuations of the selected factor of price/ cost.

1) Global market price (global market prices are usually only available for commodities)
2) Regional market price
3) Other economic allocation factors (i.e., production costs or sales price)

[Catena-X, WBCSD and TFS have already aligned on the multi-output allocation approach; this alignment still needs to be reflected in coming updates of the respective sector guidance and framework standards. Further alignment activities with other sectors will be handled via the Catena-X governance process for sector guidance acceptance. The governance process has yet to be established.]

5.2 Additional guidance

5.2.1 Prospective PCF

Fundamental considerations suggest that a distinction should be made between three types of prospective PCF depending on the point in time of the product creation process at which a PCF is quantified.

In very early phases there are only design concepts of the product and accordingly not detailed information on production processes and supply routes has been fixed yet. The uncertainty of a prospective PCF is high due to numerous unknowns. In this case a new product without forerunner shall be applied (a).

In a very late phase of the product creation process, the product may already be in serial production and the prospective PCF refers to the future performance of the existing production. Manufacturing processes can be assessed, and information from the supply chain can be gathered. The uncertainty of a prospective

PCF in this case is low due to the limited number of unknowns. In this case a further developed product with forerunner shall be applied (c).

Type “b” of a prospective PCF is introduced here, as it represents an intermediate case in terms of uncertainty. This applies when a product undergoes further development compared to a predecessor model. For the predecessor all information on manufacturing processes and supply chain are available and only the revised portions of the product introduce new and higher uncertainties.

These three types of prospective PCF will be differentiated to in this document:

a) new product without forerunner,
b) further developed product with forerunner,
c) current product for future production date

5.2.1.1 Upstream GHG emissions for a prospective PCF

In case a prospective PCF is provided for a **new product** without forerunner, LCA models that use secondary data may be applied to quantify the upstream production emissions. The applied process models shall represent those intended for series production.

In case the prospective PCF refers to a **new generation or further development of an existing product**, the upstream production emissions for the modified product portions may be quantified with LCA models that use secondary data. Also, in this case the modelled processes shall represent those intended for series production. For portions of the product that remain unchanged upstream production emissions shall be quantified based on the supply chain of the forerunner product. Reductions to these upstream emissions are only permitted if commitment from the reporting supplier can be presented at time of declaration.

In case the prospective PCF refers to an **existing product**, reductions to the upstream production emissions are only permitted if commitment from the reporting supplier can be presented.

Commitment means in this context that a written statement of the reporting supplier on the emission reduction was obtained. The proof of commitment is not required from all upstream suppliers. The commitment can also be demonstrated by a prospective PCF report form the supplier.

5.2.1.2 GHG emissions for a prospective PCF from own operations

In case a prospective PCF is provided for a **new product** without forerunner LCA models secondary data may be applied to quantify the production emissions. The applied process models shall represent those intended for series production.

In case the prospective PCF refers to a **new generation or further development of an existing product**, the production emissions for the modified product portions may be quantified with LCA models that use secondary data. Also, in this case the modelled processes shall represent those intended for series production. For portions of the product that remain unchanged production emissions shall be quantified base on the production of the forerunner product. Reductions to these emissions are only permitted if changes to established production processes can be demonstrated, or emission intensity of used energy can be justified and proven.

In case the prospective PCF refers to an **existing product**, reductions to production emissions from own operations are only permitted if improvements to the production emissions can be justified by reduced emission intensity of used energy. To justify a reduction in emission intensity of energy used, the energy supplier’s commitment, respective purchase agreements or official corporate statements on the reduction of scope 1 and 2 emissions is required.

5.2.2 Homogeneous parts

While many parts in the automotive supply chain are considered identical and require sampling strategies, there is also the related issue: Products are nearly identical but differ systematically in a single (or very few) aspect(s). This very often brings about a product carbon footprint that is identical or differs systematically with that aspect. If this applies, products are called homogeneous parts from a homogenous product family.

PCF results obtained for homogeneous parts may be used after interpolation regarding the differentiating aspect for further parts of that product family.

To belong to a homogenous product family, the products shall have the following characteristics:

- The same main function
- The same product standards
- The same manufacturing technology, processes, and materials
- The same supply routes

A homogenous product family can be substantiated if a product parameter (physical characteristic) can be identified that differentiates otherwise identical parts systematically with respect to PCF and is proven by a sensitivity analysis.

PCF results for homogeneous parts allow for a linear regression with respect to the differentiating parameter that renders a coefficient of determination $R^2 > 90\%$. Cut-off rules apply for the calculated PCF. The sample size to prove interpolation quality shall be $n > 20$.

A PCF for a part from a homogeneous product family shall be calculated by interpolation only. A homogeneous product family may be defined on the basis of an intermediate product if the final product to market is produced by varying add-on parts to the intermediate product or additional process steps, e.g., specific painting processes, additional leak tests or washing processes. For the additions in parts or processes to the intermediate product the respective CO_2 contribution shall be added to the final PCF. For the calculation of the primary data share, data does not need to originate from the product system under study, because primary data might relate to a homogeneous part.

The proof of a homogeneous product family shall be documented and provided to customers on request. A review of the proof shall be performed after five years at the latest.

Prospective PCF

The interpolation for homogeneous parts may be used in case the product in question is a future new member to a homogeneous product family. In case the interpolation of the whole product family is projected into the future, the interpolation parameters shall be recalculated based on the prospective PCF for the minimum and maximum PCF-variant of the family. The procedure is illustrated in Figure 6.

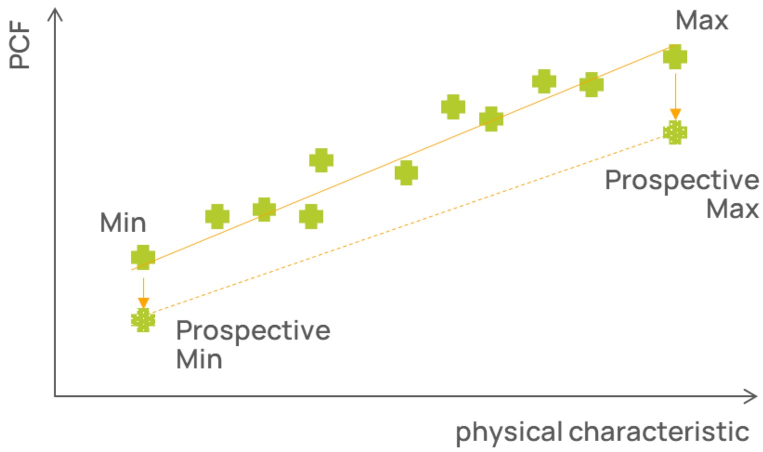


Figure 6: Interpolation line for prospective PCF of homogeneous part

5.2.3 Emissions from transportation

In addition to emissions from production and manufacturing, there are also emissions from the transportation and transshipment of products. All upstream transportation and transshipment processes shall be included in the product carbon footprint, i.e., included in the cradle-to-gate system boundaries. The same applies to in-house logistics unless cut-off rules apply (see 4.3 Cut-off-Rules). This section deals with transportation from a supplier to its customer.

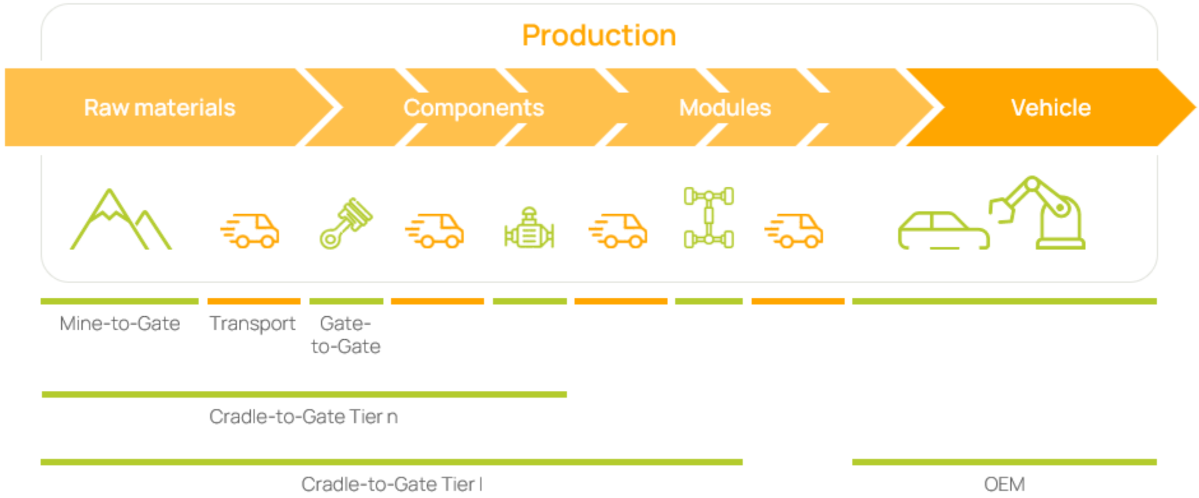


Figure 7: Definition of Scopes

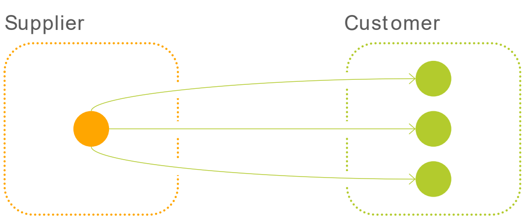
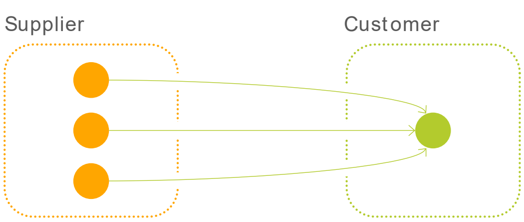
As for the product carbon footprint, the cradle-to-gate boundaries end at the suppliers' outbound gates (cf. section 4.2 System Boundaries). This boundary applies independently from the responsibilities in economic or operative terms for transportation processes.

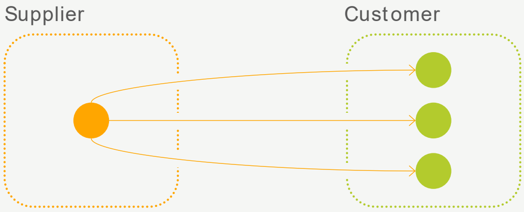
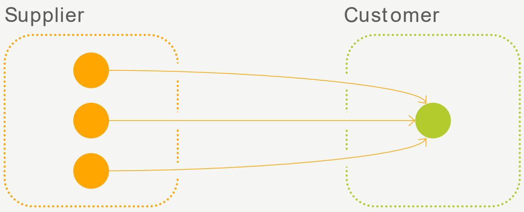
Nonetheless, if a supplier is responsible in economic or operative terms for the outbound logistics (i.e., transportation from the supplier to its customer), the supplier shall report the product carbon footprint from this transportation in addition to and separately from the product carbon footprint (Table 2). Otherwise, the customer shall account for transportation between the supplier's and its own shipping site (factory gate or distribution center, see Figure 8 and Figure 9.

The table below describes different cases of responsibility and accountability for transportation from supplier to customer:

Table 2: Transportation between supplier and customer

The responsibility to account for GHG emissions from transport depends on which party is responsible in economic or operative terms.

Case	Description	Economic/operative responsibility for transportation from supplier to customer	Accounting for transportation emissions
1	Multiple shipping sites, and/or multiple unloading sites  	Inbound transportation contracted or operated by customer	Customer responsible for quantification of transportation emissions. As for multiple transportation relations, emissions shall be attributed by mass between the respective products

Case	Description	Economic/operative responsibility for transportation from supplier to customer	Accounting for transportation emissions
2	Multiple shipping sites, and/or multiple unloading sites  	Outbound transportation contracted or operated by supplier	Transportation emissions to be reported separately by supplier to the customer (additionally to supplier's PCF). As for multiple transportation relations, emissions shall be attributed by mass between the respective products

Transports from production sites to suppliers' distribution centers are deemed as suppliers' in-house logistics, i.e., the distribution center is regarded as the shipping point.

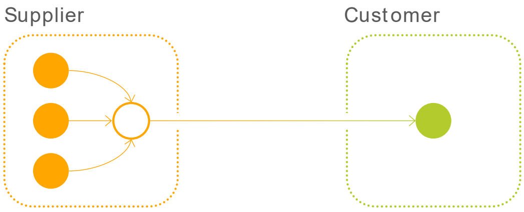


Figure 8: Distribution center on supplier side

Transports from customers' distribution centers to production sites are deemed as customers' in-house logistics, i.e., the distribution center is regarded as the unloading point.

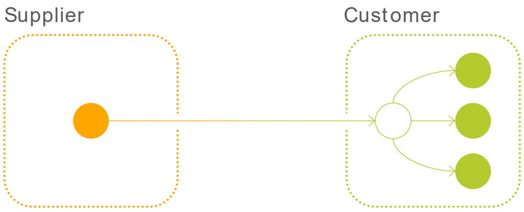


Figure 9: Distribution center on customer side

Regardless of whether transportation emissions are quantified by a supplier or a customer, they shall be consolidated within the customers' PCFs.

5.2.3.1 Accounting for transportation emissions

Emissions from transportation shall cover emissions from well-to-wheel, i.e., the system boundaries span from energy provision, production and distribution ending at the transportation operation itself. Emissions from the production of the transportation means and infrastructure, e.g., roads, vehicles, ships and railways, shall not be included.

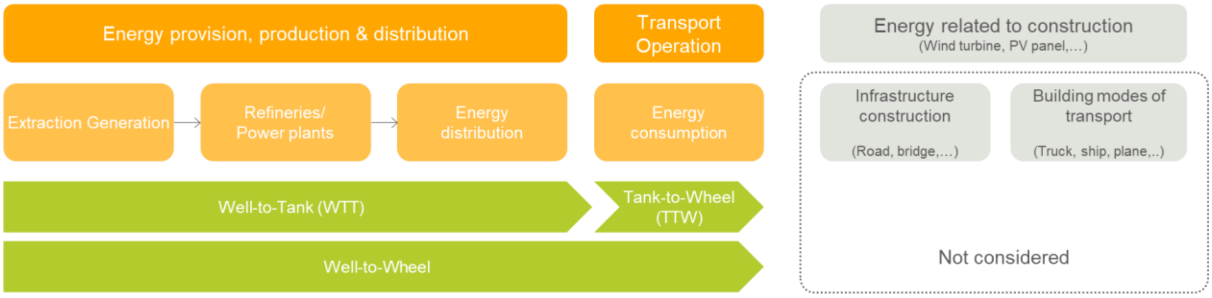


Figure 10: System boundaries for transportation

In case of transport chains (transport of a product by more than one transport mode) the chain links shall be individually quantified and subsequently summed up.

Consistent with the Catena-X goal of basing PCF quantification on primary data, the ultimate approach of quantifying transportation emissions shall be based on measuring the fuel and energy consumption of a trip and multiplying it by the emission factor of the fuel/energy that covers all upstream emissions of the fuel/energy. In case of collective transport operations the primary data based transport emissions require allocation to the individual product. Such allocations do not change the classification of emission data as being primary data.

Direct measurement of fuel/energy consumption of a transport operation may however not always be possible and modelling transport emissions is required. Calculation of transport emissions shall follow the recommendation set out in the latest GLEC Framework. The GLEC framework allows for three approaches to establish transport distances: Shortest feasible distance (SFD), great circle distance (GCD) and actual distance. These approaches shall be used according to the following hierarchy:

- Actual distance
- SFD
- GCD

To perform the calculation, tools verified according to the GLEC framework may be used, for example, but not limited to:

- CarbonCare CO_2-Emissionsrechner
- EcoTransIT Emission Calculator

Emissions reduction from the use of low-carbon fuels may only be claimed if a statement of sustainability (origin and emissions reduction) for the fuel is provided as issued by a bonded warehouse. A tradeable certificate is required.

Prospective PCF

In case transport emissions for an **existing product** need to be quantified, any changes to the current transport emissions need to be justified by commitments of the logistic companies.

The same applies to unaltered portions of a **product with a forerunner product**. Only modified portions can be subject to modelling the transport emissions.

In case of a **product without any forerunner** product transport emissions require modelling.

For the not yet determined shipping points/route of a transported good an assumption concerning the predominant origin of this product in the company's own supply chain shall be set. The most common mode of transport/transport chain shall be assumed for the defined shipping route. Subsequently, the transport distance shall be established according to the GLEC framework. To perform the calculation, tools certified according to the GLEC framework may be used.

5.2.4 Accounting for waste treatment

Waste is any material or process output which is not deliberately produced as an integral part of a multi-output production process. No further use of the material or process output is certain. Additionally, the holder discards or intends to discard or is legally required to discard the residue based on national waste legislation.

Waste materials with certain further use but requiring further treatment other than normal industrial practice before use (i.e., waste recovered by recycling) shall follow the requirements laid down in section 5.2.5 on material recycling.

"Normal industrial practice" can include all steps which a producer would take for a product, such as the material being filtered, washed, or dried; or adding materials necessary for further use; or carrying out quality control. However, treatments usually considered as a recovery operation cannot, in principle, be considered as normal industrial practice in this sense. Some of such processing tasks considered as normal industrial practice can be carried out on the production site of the manufacturer, some on the site of the next user, and some by intermediaries, as long as they also meet the criterion of being 'produced as an integral part of a production process' (adopted from the EU's Guidance on the interpretation of key provisions of Directive 2008/98/EC on waste).

A **co-product** in contrast is produced as an integral part of a multi-output process where its further use is certain. Typically, co-products directly replace a raw material or fuel without requiring further processing other than normal industry practice. For co-product allocation, multi-output allocation applies (please refer to section 5.1.2).

The following hierarchy shall be applied (please refer to Annex A.2 for definitions of the respective criteria):

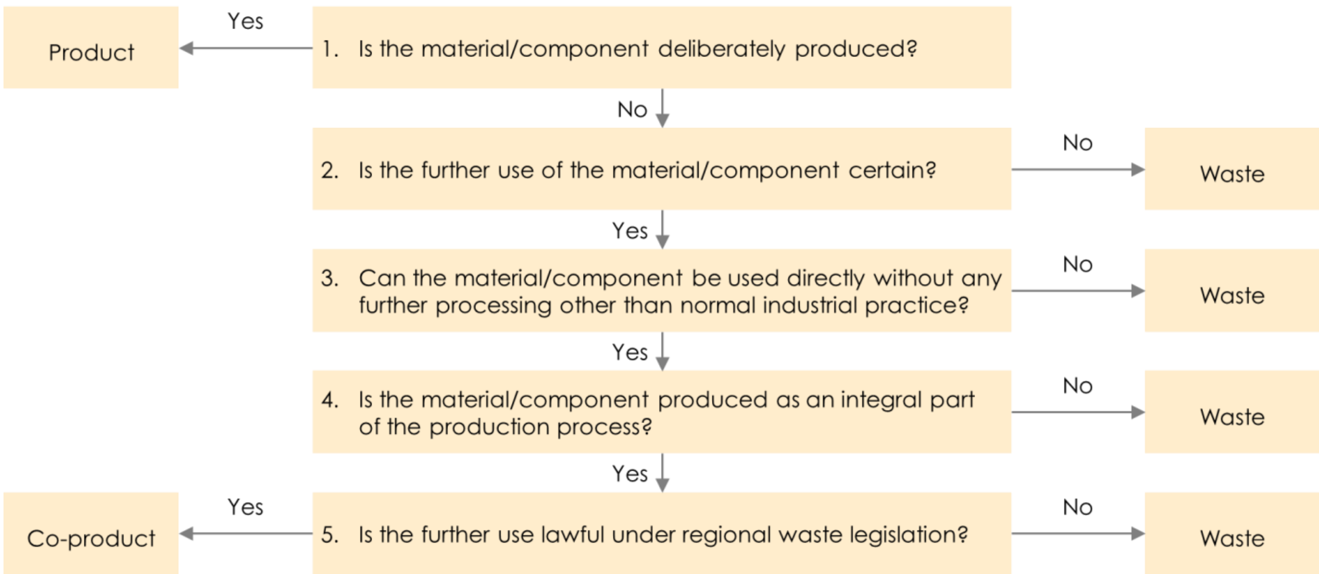


Figure 11: Waste vs. co-product classification hierarchy based on EU Waste Framework Directive

Residues classified as waste following the hierarchy can also be transformed into recycled feedstock. However, this transformation would require further processing other than normal industry practice (see point 3 in Figure 11), such that the residue would be classified as waste in the first instance.

Pre-consumer scrap that is not reintroduced into the same process shall be defined as waste unless legal evidence (following legislation of the region where scrap is generated, e.g., legal judgement or legal report from regional waste legislation) exists that classifies the pre-consumer scrap material as co-product.

Any GHG emissions arising from the treatment of production waste shall be included in the total PCF. Since the Catena-X boundaries span from cradle-to-gate, this production waste treatment refers to the production life cycle stage only.

Waste can be generated during different stages of a product's life cycle (cradle-to-gate), including (see Figure 12):

- Resource extraction, raw material sourcing
- Production of materials, semi-finished products
- Production of vehicle parts and components
- Logistics to supplier gate (including internal logistics)

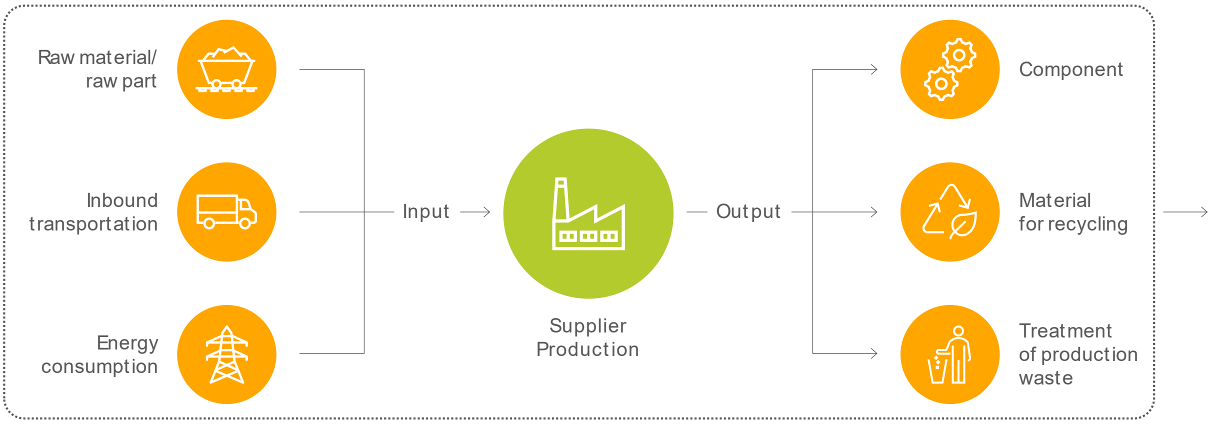


Figure 12: Waste generation during different stages of a product's life cycle

All auxiliaries and energy inputs and waste outputs shall be fully considered in the calculation of the product carbon footprint. Cut-off rules as described in section 4.3 shall be applied.

The company generating waste is responsible for treatment until final disposal (for example, incineration or landfill). This is also referred to as the "polluter pays principle". If additional processes follow the end-of-waste state, then these are attributed to the company using the recycled or reused material flow as a secondary material.

The impact of preparatory steps and supporting activities such as collection, transportation, sorting, dismantling, or shredding shall be added to the inventory results of the product system generating the waste.

The impact of the process treating waste with energy recovery (e.g., incineration) shall be added to the inventory results of the product system that generated the waste treated in the process.
For incineration, credits are not considered, only incineration process impacts shall be taken into account. The energy recovered from the waste-to-energy process shall be treated as free of burdens. Burdens or credits associated with previous or subsequent life cycles are not considered. The general practice in the automotive industry is following the polluter pays principle, i.e., allocating waste treatment emissions to the product system generating the waste.

Production processes may also generate material scrap that is recycled. In this case, please see section 5.2.5 Allocation in case of recycling.

GHG emissions shall be calculated using primary data regarding the type of waste, its composition and type of waste treatment activity. Depending on the type of waste treatment (for example landfill or incineration), companies may use waste treatment emission factors based on internal primary data. If no primary emission factors are available, emission factors derived from secondary databases can be employed (section 6.2).

If companies do not have access to primary data from third-party waste treatment facilities, they should estimate waste treatment emissions based on primary data on the waste type and composition and specific emission factors according to the quantity and type of waste treatment and final disposal (landfill, incineration).

5.2.5 Accounting for recycling (within the transition period)

Recycling plays a crucial role in enabling a circular economy and reaching climate protection goals. In particular, recycling of currently unused or inefficiently used material streams is key to reducing primary material use as well as environmental burdens related to current waste treatment. The environmental burden of the recycling process needs to be distributed between the systems receiving and providing the secondary material.

Catena-X acknowledges steering effects of selecting different allocation approaches. Shifting the environmental burden of the recycling process may create an increasing demand for recycled material. These steering effects can lead to technology shifts, enabling emission reductions and/or increased material efficiency in the industry.

The allocation hierarchy in ISO 14044 does not account for the steering effects and no specific allocation hierarchy for recycling is provided. In principle, ISO 14044 applies the same allocation hierarchy for multi-output systems. However, specific assessment approaches for recycling are described in ISO 14044: Avoided burden for the primary production route and cut-off. Avoided burden of the primary production route usually incentivizes the provision of material for recycling at the end-of-life and, thus should only be applied if these incentives lead to overall emission reductions. However, if environmental incentives can lead to overall emission reductions, this highly depends on the market situation and requires a detailed analysis. Consequently, the cut-off approach shall be applied due to the following reasons:

- Ease of use in a Catena-X network
- Avoidance of double counting
- Higher comparability of PCFs within Catena-X

The product system generating material for recycling follows a cut-off approach in a cradle-to-gate scope. Preparatory steps for recycling shall generally be allocated to the waste receiving system (i.e., the product system using the (to be) recycled material). This deviation from the polluter pays principle (as required for waste-to-energy, incineration, or disposal emissions) is a pragmatic exemption as following the polluter pays principle in this context would require defining material- and component-specific system boundaries. Other than the emissions from the respective preparatory steps and the recycling treatment emissions, to be recycled, to be re-used, or to be re-manufactured materials enter the product system using recycled material burden-free.

For pre-consumer scrap, preparatory steps owned by the company generating the waste shall be accounted for by the producer of the waste (they might be insignificant; cut-off rules apply).

5.2.5.1 Accounting for recycling (after the transition period)

Catena-X acknowledges the environmental steering effects of selecting allocation approaches and hence may prescribe other allocation approaches to specific materials and regions in the future.

The allocation methods described in sector-specific guidelines may serve as the basis for deciding if other allocation methods are prescribed.

For PCF reporting according to Catena-X the cut-off applies.

5.2.6 Accounting for GHG emissions from electricity

For each process step within the Catena-X boundaries that requires electricity, companies must determine which GHGs were emitted by this specific energy use. All GHG emissions resulting from the use of the required electricity during the production process (cradle-to-gate) shall be included in the product carbon footprint. Contrary to the general definition of the system boundaries, which exclude emissions from construction and decommissioning of infrastructure (in the following referred to as infrastructure emission), these are included for the electricity infrastructure. The transition to renewable and non-dispatchable energy generators results in additional emissions that should be reflected in a PCF.

To calculate the share of electricity consumption in the product carbon footprint, generator-specific emission factors shall be used. Depending on the type of electricity generation, different amounts of greenhouse gases are emitted. The factors used shall take into account upstream emissions (e.g., the mining and transport of fuel to the electricity plant or the growing and processing of biomass for use as an energy source), emissions during the generation of electricity (e.g., combustion of fossil fuels) including losses during transmission and distribution and downstream emissions (e.g., the treatment of waste arising from the electricity plants). The inclusion of infrastructure emissions shall be handled specifically according to the way a consumer is connected to electricity generators and the consumers demand profile. Connecting to the electricity grid generally allows a consumer to receive electricity on demand. The electricity system has to ensure that power demand and power generation is in balance at any instance. This system feature requires considerable additional efforts on the infrastructure side beyond installing the nominal renewable energy generation capacity. Energy storage, conversion, back-up generation and additional transmission capacities are required as even higher shares of non-dispatchable energy generators (e.g. wind turbines and solar panels) enter into the electricity system. The electricity **system** infrastructure emissions therefore need to be quantified.

5.2.6.1 Electricity from a directly and dedicated connected generator

If electricity is produced on site with a direct connection to the power generator (e.g., photovoltaic plant on the roof, wind park beside the production facility, own fossil power plant) or a direct connection to a power generator operated by a power supplier, the amount of electricity consumed from this power generator and the related emission factor shall be used if no contractual instruments have been sold to a third party. Otherwise, the electricity shall be considered as provided from the grid.

As verification of using electricity from the company's own facilities, proof of installation of the company's own generation technology as well as a meter reading shall be available. The amount of electricity and the period of the meter reading shall be equal to the amount of electricity required and the respective period. In addition, the meter reading should be confirmed by a third party to prove that the specified generation technology, the respective period and the amount of electricity generated are in fact as stated.

The infrastructure emissions shall be reported for the specific generator type (e.g. onshore wind turbine, solar panel, etc.) reflecting the specific emissions from the construction and decommissioning of the generator as well as the respective local capacity factor and lifetime definitions.

5.2.6.2 Electricity from the grid (by a power supplier or) via contractual instruments

If electricity is accessed via a contractual instrument, the following electricity mix shall be used:

1. Supplier-specific electricity product shall be used if:

- a tracking system is installed in the country.
- the set of minimum criteria to ensure the contractual instruments are reliable is met, i.e., no double counting and no exclusions.

2. Total supplier-specific electricity mix, i.e., the share of electricity supply specific to the supplier, shall be used if the set of minimum criteria is met to ensure the contractual instruments are reliable.

Otherwise, the country-specific residual grid mix (consumption mix) shall be used (such as AIB[5] for Europe). Country-specific means the country in which the activity occurs.
If residual grid mixes are not available, grid-specific fossil mixes shall be used.
In case secondary data are used that include country specific grid mixes, and with reasonable effort it is not possible, to replace those by residual fossil grid mixes, these data sets are admissible.

5.2.6.2.1 Contractual instruments

In general, three different reference types can be defined for contractual instruments:

Utility Tariffs
When using an electricity supply contract, electricity is purchased from a supplier via the public grid.

Energy Attribute Certificates (EACs)
EACs should enable renewable energy to be tradable. An EAC is a certificate that proves that one megawatt hour of electricity was generated from renewable energy and transferred into the electricity grid. EACs can be separated from the physical quantity of electricity and therefore traded independently. Depending on the region, different systems are in place for trading Energy Attribute Certificates. For example, International Renewable Energy Certificates (iRECs) are traded through an international registry as a renewable energy instrument. In contrast, Renewable Energy Certificates (RECs) or Guarantees of Origin (GoOs) are examples of verification instruments in specific regions.

Power Purchase Agreements (PPAs)
A PPA is an electricity supply contract concluded directly between an electricity producer (plant operator) and an electricity consumer. The contract specifies the delivery of a certain amount of electricity over a particular period at an agreed price. In general, the types of PPAs can be differentiated. There are physical PPAs, which can be further subdivided into on-site and off-site, and virtual PPAs.
Electricity from PPAs can only be considered as eligible linked with EACs.

The contractual instrument used to calculate the related emission factor shall meet the following minimum criteria:

- It shall convey the information associated with the unit of electricity delivered together with the characteristics of the generator.

[5] Available at https://www.aib-net.org/facts/european-residual-mix

- It shall be assured with a unique claim and therefore be the only instruments that carry the environmental attribute claim associated with that quantity of electricity generated.
- It shall be tracked and redeemed, retired or cancelled by or on behalf of the company (e.g., by an audit of contracts, third-party certification, or may be handled automatically through other disclosure registries, systems, or mechanisms).
- It shall refer to the same year to which the contractual instrument is applied.
- The attribute tracking instrument shall refer to an electricity production asset located in the same regional market (within which an interconnection can be proven).

If minimum criteria are not met the fossil grid mix shall be used.

If in a region no contractual instruments concerning the carbon intensity of electricity are available, the location-based reporting with the country specific grid mix shall be used.

If the electricity consumed comes from more than one electricity mix, each mix source shall be used in terms of its proportion in the total kWh consumed. If a certificate of origin covers only a part of the consumed electricity, the residual grid mix shall be used for the uncovered amount.

Since Electricity Attribute Certificates (EACs) typically do not contain explicit emission factors, but rather indicate the generator type and geographical location, it is acceptable to use emission factors from secondary databases that correspond to the technology type and region.

In addition to the emission factors as shown in the contractual instrument of the electricity, the following GHG emissions shall be taken into account:

- Upstream emissions (e.g., the mining and transport of fuel to the electricity plant, the growing and processing of biomass for use as an energy source or construction and maintenance)
- Downstream emissions (e.g., the treatment of waste arising from the electricity plants)
- Infrastructure emissions:
    - If contractual instruments define the generator form (e.g. wind or solar power) from which the energy is purchased ´as produced´, the infrastructure emissions, as defined for a direct connection (see 5.2.6.1), are to be included, along with the infrastructure emissions for the transmission network. The latter are currently not quantified, and omission is therefore accepted for the time being.
    - If contractual instruments do not define a specific generation profile the system infrastructure emissions shall be added. As this is currently not quantified in a systematic and regular manner, the infrastructure emission shall be determined from the annual non-dispatchable renewable energy, the split of installed generator capacity the specific emissions from the construction and decommissioning of the generator and the respective life-time definition.
    - If in absence of contractual instruments, the residual or fossil grid mix is applied, dispatchable generators shall be assumed for which infrastructure emissions are typically neglectable and shall be stated as such.

Prospective PCF

For prospective PCF: If a commitment is made to use a certain generator/power supplier (e.g. wind power) by the company, it shall be eligible to use the emission factor for the committed type of power generation. If there is no commitment the electricity for the company's own operations shall be accounted by using the residual grid mix for the region or country of the foreseen manufacturing site. In case upstream production emissions are estimated via LCA models from secondary sources the future location-based consumption mix according to IEA STEPS scenario may be used.

A commitment may be evidenced by a contracted green energy procurement for the PCF's reference period with corresponding EACs or a written obligation to enter into such green energy procurement. Alternatively, a corporate commitment e.g. documented in the company's sustainability report shall suffice as evidence. On-site energy production and dedicated connections follow the same guidelines as a retrospective PCF.

5.2.7 Accounting for chain of custody models

Chain of custody is an administrative process by which information about materials is transferred, monitored, and controlled as those materials move through supply chains [ISO 22095:2020]. There are, in principle, five possible chain of custody models, illustrated in Figure 13. Their common objective is to guarantee correct accounting and corroborate a link between ingoing content, e.g., ‘sustainable’, ‘recycled’ or ‘organic’ by harmonized definitions, and the final outgoing product. They differ whether it is a physical or administrative link. Furthermore, they differ in the set of rules for balancing, and the option to keep materials streams segregated or not[6].

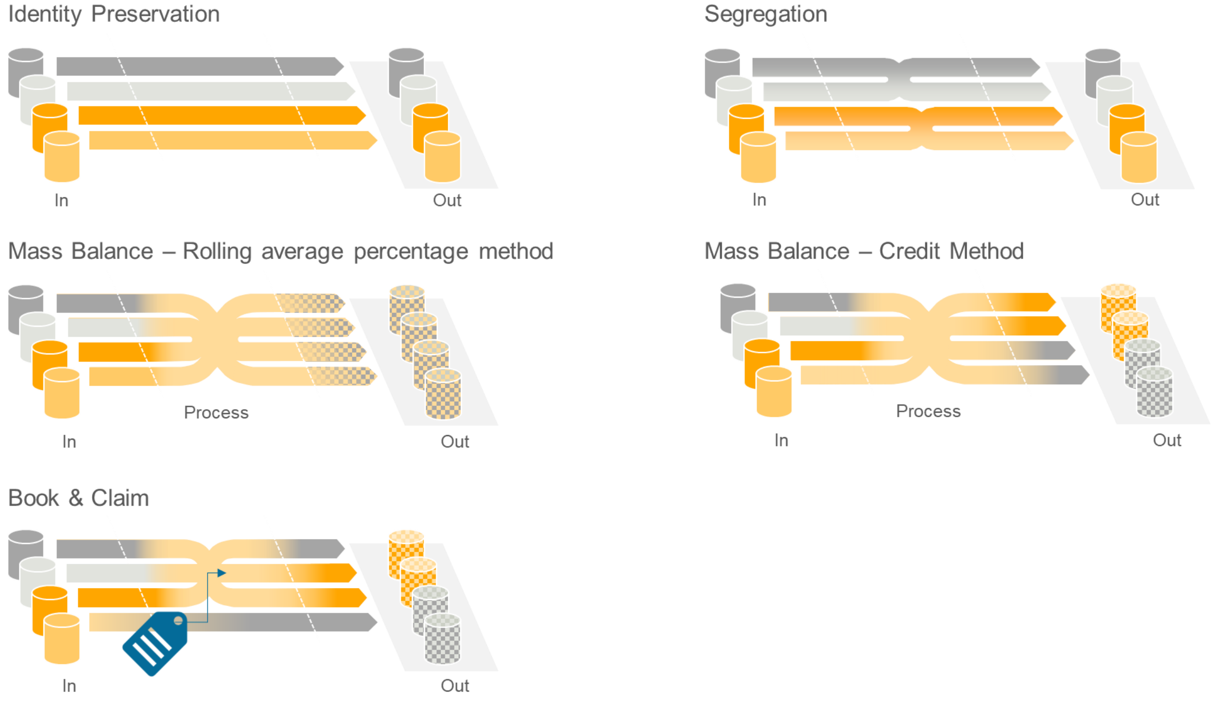


Figure 13: Overview of chain of custody models

The following table provides high-level explanations and differentiations for the chain of custody models:

Table 3: Explanation chain of custody models

[adapted from the EMF Whitepaper: “Enabling a circular economy for chemicals with the mass balance approach” Table 1, page 11]

Model	Explanation	Example
Identity preservation	It is possible to physically track the product to its desired origin, ensuring unique traceability and physical separation of products from other sources along the supply chain.	Buying food from a single certified producer.
Segregation	Consists in the aggregation of volumes of products of identical origin or produced according to the same standards in one stock item.	Buying food from a trader that exclusively handles identically certified supplies

[6] Source: https://www.ellenmacarthurfoundation.org/white-papers-and-articles

Model	Explanation	Example
Mass balance	Considering the output, no physical or chemical difference exists between in-scope and out-of-scope. It involves balancing volume reconciliation to ensure the exact volumes of in and out-of-scope source is maintained along the supply chain. Given that the volume or the ratio of sustainable material integrated is reflected in the product produced and sold to customers. This model requires that a reconciliation period is defined (e.g., a month, a year).	Buying a certain percentage of a supply from certified origin. Applies to, e.g., sustainable forestry for wooden materials, recycled, bio-based or renewable materials, organic cotton
Rolling average percentage method	The rolling average percentage method is based on the use of a fluctuating proportion of input bearing specified characteristics entering the organization over a defined claim period, allowing a claim of an average percentage to be made for the output over the claim period. This means the attributes are allocated as a time-averaged value across a process chain or production sites.	
Credit method	The credit method is applicable when two or more types of input are used for a product. The output amount of each type is equivalent to the input, taking into account the conversion factor. The conversion factor is defined within each product and is applied to define the amount of credit to enter the credit account. Credits enter the account with the input or they are withdrawn by assigning it to the output… , This means that the attributes are specifically assigned to individual products based on defined criteria.	
Book and claim – restricted certificate trading	The certified product/component is disconnected from the certification data but belongs to the same production system or value chain. The certified product evolves in separate flows from the certified supply. Certificates are issued at the beginning of the supply chain by an independent body reflecting the sustainable content of supplies. The intended outcome is that outputs from one supply chain is associated with total claims corresponding to the certified input.	Buying material with renewable/recycled/ biobased content. Certificates with guarantee of origin or comparable certifications declaring e.g., recycled, renewable, biobased content.

The rolling average percentage method and the credit method are special cases of mass balance and were added subsequently.

The mass balance approach is intended to enable the transition from fossil raw materials to more sustainable alternative materials (e.g., scrap or bio-based materials).

Only clearly product related Chain of Custody Models may be used. That means that the book and claim method is, by default not an applicable method to use. This rule does not apply to energy carriers such as electricity, fuels and biomethane. For these purposes the book and claim method can be applied.

5.2.7.1 Guiding principles

In implementing chain-of-custody methods, including mass balancing, the following set of guiding principles shall be fulfilled:

1. The use of chain-of-custody approaches shall achieve significant changes and an effective transition towards a lower GHG emissions production in complex value chains.
2. The choice and implementation of chain-of-custody approaches and models shall be transparent, clear, credible and verifiable. Established certificate systems like REDCert II and ISCC Plus can be used if they follow the specifications for mass balancing in this chapter. Proof must be submitted by the organization using the certificate, i.e. the company producing the product that was verified according to the scheme.

Labels and claims referring to chain-of-custody controlled specified characteristics and used on products shall fulfill the following requirements:

- description of the chain-of-custody approaches and models
- accurate and appropriate implementation of the chain-of-custody model

If the "specified characteristic" content in products cannot be measured and verified, labels and claims shall mention this. This often applies to mass balancing, e.g. chemically recycled content in plastics.

3. No double counting: A reliable accounting system shall be installed at each operating site to ensure that the claimed volume on the output side exactly matches the actual volume on the input side within the declared time and regional scope.
4. For each material or product, claim periods shall be defined, which shall correspond to the claimed relation of the input to the output. These input and output claim periods shall not exceed the defined time period of reporting (max. 1 year)
5. The operating sites in the spatial boundaries for mass balancing are under the operational control of the same company/ corporate group/ joint venture.

Additional requirements for a mass balance credit method

6. It shall be technically possible according to standard industry practice to produce a mass-balanced product from an alternative feedstock. The share of the balanced input shall not exceed the maximum technically possible share for this process route (e.g. Blast furnace route vs. Electric arc furnace route for steel).
7. Only additional measures relative to the PCF of the residual product shall be considered. The residual product is the product without reduction measures used in mass balance within the respective reporting year.
8. Physical traceability of the material in the supply chain: By default it shall be possible for portions of the material to be physically present in the product.
9. Technical equivalence: The product must possess the same technical properties as the equivalent product without applied measures.

Continuous production processes in downstream vehicle (component) production can entail challenges in the attribution of sustainable characteristics to products within single sites. A multi-site mass balance (i.e. multi-site credit transfer) may be applied within integrated economic areas (e.g., European Economic Area (EEA), USA, China) in cases where a site-specific mass balance leads to an unintended increase in GHG emissions compared to a multi-site mass balance.

The multi-site mass balance must be certified or verified externally (e.g. by an accredited certifier or verifier). The requirements for a site-specific mass balance shall equally be applied for multi-site regional mass balances. It shall be made transparent if multi-site transfer is applied.

6. Data sources and hierarchy

6.1 Primary data

Primary data is a quantified value of a process, an activity obtained from a direct measurement, or a calculation based on direct measurements.

Efforts shall be taken to increase the share of primary data as well as achieve high data quality for both secondary and primary data, for data quality rating see section 7.2.

Primary data shall include primary activity data, i.e., a technical flow, and primary GHG emission factor, i.e., the carbon footprint of the corresponding activity expressed in $kgCO_2eq$ per unit (Table 4). Consequently, the measured materials consumptions and a secondary GHG emission factor is not considered primary (see section 7.2). Primary data may be obtained through meter readings, purchase records, utility bills, engineering models, direct monitoring, material or product balances, stoichiometry or other methods for obtaining data from specific processes in the value chain of the company.

Measurements used in combination with stoichiometric relations — such as calculating GHG emissions from measured fuel consumption — are also judged as primary data. For the combustion of standard fuels qualities (as e.g. Diesel B7 or Gasoline E10), their respective emission factors shall be considered as primary data; upstream shall be considered separately

In addition, emission factors derived from Electricity Attribute Certificates (EACs), when matched to the generator type and location using recognized secondary databases as described in section 5.2.6, may also be considered primary data.

A single calculation might include both primary, secondary data and a mix of both expressed by the primary data share (see section 7.2.4). For example, calculating emissions from the consumption of electricity could involve primary activity data, such as data on consumption in kWh, multiplied by a secondary emission factor provided by secondary data bases representing GHG emission intensity (CO_2eq per kWh).

Table 4: Possible variances of primary and secondary data

Approach	Direct emission measurement			
Primary data, if	Source of emission is within company boundaries and is measured			
Approach	Activity data source		Emission factor source	
	Energy	Material	Energy	Material
Primary data, if	Consumption measured (primary)		For on-site production Emission measured (primary) For supplier-specific electricity: Primary with guarantee of origin	Measured and reported as a share by supplier
Secondary data, if	Consumption/production measured (primary)		Secondary databases, data proxy	

The data may need to be scaled, aggregated, or otherwise mathematically processed to relate it to the declared unit or the reference flow of the process (see section 5.1). Mathematical modelling may be used to fill in the missing data, or data aggregation may be required to attenuate the effect of revisions, turnarounds, or other atypical production conditions.

If no product-specific measurement or calculation of activity data or emission factors are available, feasible site-specific or even company-specific data shall be used, which might incorporate more than production related emissions, e.g., emissions related to research and development.

6.2 Secondary data

Catena-X pursues the goal of calculating PCF based on primary data. This, however, will not be feasible from the onset of Catena-X as primary data will not be widely available in the short term. At least during this transitional phase, secondary data is required to ensure the information chain on PCF is not interrupted.

Ideally, the use of secondary data warrants the following crucial requirements:

When using secondary data, a conservative estimate shall be applied.
Even if the use of secondary data is required, any competitive distortion shall be avoided (if knowledge of a material is limited to virgin aluminum from Canada produced in 2020, this should result in an unequivocal CO_2eq intensity for that material).
The selection of secondary data shall be guided by the representativeness criteria (see section 7.2.5) to limit errors introduced into the PCF calculation. The effort to search for data with the fewest errors needs to be balanced with economic feasibility to the extent that misleading results are avoided.
Secondary data shall be accessible to all Catena-X members, regardless of size, economic power or experience in life cycle assessment.

For use within Catena-X, there are three principal approaches to harmonize the use of secondary data with respect to the requirements mentioned above:

- Definition of CX-prescriptive secondary data
- Definition of a whitelist of data sources
- Definition of hierarchy for secondary data sources

Combinations of the approaches are also feasible.

With regard to the above-mentioned requirements, the first option is clearly the superior approach. By prescribing the use of specific secondary data with adequate precision and following a conservative approach, comparability of results and avoiding underestimation of PCFs can be ensured. Harmonized and prescribed data sources ensure that unequivocal CO_2eq intensities are applied, and each CX-member has access to the same data. A fully harmonized prescribed set of data provided by Catena-X would also eliminate the need to define and do any data quality rating.

The issue is the effort required to research and prepare the likely large amount of data which is needed to cover the full supply chain and to keep such data up to date over the years to come. One has to keep in mind however, without a CX-prescriptive database, the effort to define criteria for appropriate data is still required and the time required to identify and research appropriate and accepted data will be spent multiple times by every PCF/LCA expert in each company in need of secondary PCF data. Most likely, data quality checks and reviews will increase individual efforts further with no guarantee that competitive distortion can be avoided. The risk of a race to the lowest possible PCF results that can be argued with permissible creativity needs attention.

The actual drawback is thus not the high effort to provide CX prescriptive data, but the need to provide this effort upfront and centrally from the CX side. A pragmatic solution with the support of various associations seems to be the most viable way forward.

For a web application that allows SMEs to calculate PCFs a CX prescriptive database with no or moderate licensing fees seems to be the only solution.

Defining a hierarchical list of secondary data sources starting with association data already follows the logic of a CX prescriptive database. The shortcomings are possible multiple references to the same material from different associations and the opening clause to universal databases whenever one seems to find no appropriate piece of data in the associations data. This already indicates that avoiding arbitrary evasion of universal databases will require a set of rules/criteria regarding which approximations are permissible and CX-compliant and which are not.

A non-hierarchical list or whitelist of data sources would require the set of rules/criteria with approximations of the real data by secondary data is sufficient to an even larger extent. To ensure a conservative data choice that does not undermine the use of sound primary data seems hardly possible. A whitelist of data sources would even require CX to review and approve the data content and ensure completeness.

As a bottom line, providing a harmonized set of industry association data as prescriptive for CX is the superior approach. As of now, this harmonized data does not yet exist and CX will thus require hierarchical use of secondary data sources in the following sequence:

1. Industry association data
2. General LCA data, e.g., commercial databases
3. Other documented references, e.g., scientific literature

If secondary data are not available within the references listed, other sources can be used to fill data gaps. If no data is available at all, proxy data may be used. The employment of proxy data sources shall be documented and made transparent to auditors and recipients of any data (see section 7.2.5).

The particular value of association data is the higher certainty that the CO_2eq intensities represent an industry/sector average and, in some cases, even indicate the dispersion of CO_2eq intensities around the average value. CX will initiate the work on harmonized industry association data.

Additional quality rules for secondary data usage

Secondary data that is used as emission factors shall be selected according to the following criteria:

Temporal representativeness:
The reference year for the secondary data shall correspond to the assessment period of the activity data. For instance, the electricity consumption mix corresponding to the year of assessment, or the most representative year shall be employed for the calculations.

Geographical representativeness:
The geography of the data shall correspond to the activity data most geographically relevant to the process. For instance, the electricity consumption mix corresponding to the geography of the product (country or state if available) shall be employed for the calculations.

Technological representativeness: The secondary data source shall correspond to the activity data that is technologically representative of the process. For instance, the electricity or heating generation mix shall be representative of the source of energy used.

7. Required elements for PCF data exchange

Standardized PCF accounting and data exchange constitutes an important step toward creating comparable and consistent emissions data. Another factor to enhance comparability and consistency is the standardized sharing of elements of meta data relating to the PCF between stakeholders within the supply chain, as this is a prerequisite for more granular and accurate calculations by each stakeholder.

Emissions data calculated in line with the CX Framework shall therefore be shared in accordance with the guidelines set out in this section.

PCF calculation is based on multiple input data that require proper documentation but no communication along the supply chain. The data model defines which attributes are passed on from supplier to customer.

7.1 Data model

The CX data model specifies the information that companies must adhere to when reporting their PCF in accordance with the requirements of this CX-PCF Rulebook

A report on the full technical specification will be included in a separate document.

Prospective PCF

Three types of prospective PCF (see 5.2.1) shall be indicated in the data model:

a) new product without forerunner,
b) further developed product with forerunner,
c) current product for future production date

7.2 Details on the required data elements

7.2.1 Time period

Emissions shall by default be reported averaged over the period of one year (reporting or calendar year) to avoid seasonal fluctuations and reflect typical production conditions.

Shorter periods may be considered if data on a full year are not yet available. Longer averaging periods may be considered but shall not exceed three years. Any averaging period deviating from the default shall be flagged and justified.

Prospective PCF

For a prospective PCF, a defined period of one year shall be taken into account. For example, the Start-of-Production (SoP) year using planning values and reference consumption from existing facilities. Reference consumption from existing facilities shall reflect annual average values to balance out seasonal fluctuations.

For simplification the reference values shall refer to a steady-state production situation neglecting any volume ramp-up effects.

7.2.2 Temporal validity

Emissions should by default be reported for the most recent year (reporting or calendar year). The activity data from own operations should be from the previous year. After the transition period activity data from own operations shall be from the previous year.

An annual check is mandatory to ensure data actuality. To perform the annual check, the initial screening analysis should be updated based on data for the most recent year. This annual check shall include changes in the supply chain data and in secondary data (e.g. emissions factors).

An update of data is mandatory if the reported emission increases by 10% or more based on the screening analysis compared to the previous reporting period. Additionally, an update of data is mandatory in the following situations (adapted from GHG protocol):

- Structural changes in operation to the product system under study, including significant process change in operation, technology advancement, raw material or energy changes.
- Changes in calculation methodology (e.g. resulting from a new version of this PCF rulebook) or improvements in the accuracy of emission factors or activity data or inclusion of new types of

sources that result in a significant impact on the emissions data. Discovery of significant errors, or a number of cumulative errors that are collectively significant.

Prospective PCF
For a prospective PCF no annual checks are mandatory. An update shall only be provided on demand.

7.2.3 Geography

Emissions shall by default be reported on the plant level. Averaging over a region or country may be considered but shall be flagged as such.

7.2.4 Primary data share

To create visibility on the share of primary data in PCF calculations, the primary data share (PDS) indicator in each data set shall be determined and shared. The Primary Data Share (PDS) is defined as the proportion (percentage) of a PCF that is derived from primary data (as defined in section 6.1).

To ensure that a consistent PDS can be reported no matter if reporting is done stepwise or collectively for multiple steps, the percentage of the primary data shall relate to the absolute sum of all positive or negative PCF contributions (PCF_{as}). Otherwise, negative emissions would lead to wrong weighting of contributions to the aggregated PDS.

For the PCF excluding biogenic CO_2, the absolute value is identical to the Total PCF excluding biogenic, because no negative values occur.

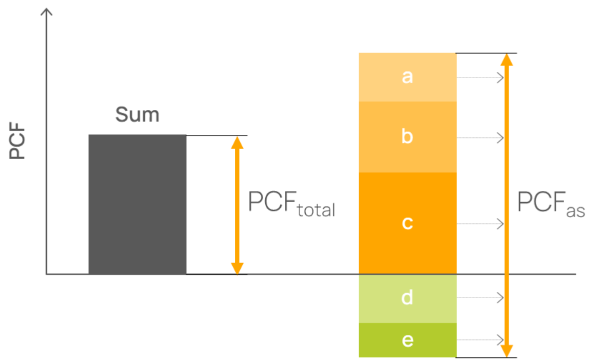
Introduction of the PDS for PCF including biogenic CO_2 uptake
Biogenic emissions have a negative PCF value when using the -1/+1 approach. Therefore, the net value (total PCF including biogenic CO_2) has a lower value than the sum of all its absolute contributions. -1+1 = 0 vs absolute value |-1| + |1| = 2 For the PDS including biogenic CO_2 an absolute value PCF has to be used to consider that positive and negative emissions have an influence on the PDS. Otherwise, the above described wrong weighting would occur and could even lead to a negative primary data share or a primary data share above 100 percent.

The primary data share is calculated based on all contributions to the PCF caused by the company itself and in the upstream activities and emissions.

If a system expansion or an allocation is necessary, these have no influence on the value of the primary data share itself. All main and co-products from one unit process therefore have the same PDS.

Figure 14 illustrates the definition of PCF_{as}.

$$PCF_{as} = \sum_i |PCF_i|$$



Contribution	PCF_i	$PCF_{total,i}$	$PCF_{as,i}$
a	1.00	1.00	1.00
b	1.50	1.50	1.50
c	2.00	2.00	2.00
d	-1.00	-1.00	1.00
e	-0.75	-0.75	0.75
Results		2.75	6.25

Figure 14: Definition of PCFas: a-e represent contributions to the PCF; d and e are biogenic CO_2

Having introduced PCF_{as} the primary data share can now be defined:

$$PDS_{PCF} = \frac{|Amount\ of\ emissions\ based\ on\ primary\ data\ |}{PCF_{as}}$$

The aggregated primary data share for multiple PCF contributions reported with individual PDS (PDS_i)

$$PDS_{aggregated} = \frac{\sum_i (PCF_{as,i} \cdot PDS_i)}{\sum_i PCF_{as,i}}$$

All PCF values have the unit $kgCO_2eq$.

As an example, three suppliers, Company A, Company B and Company C, provide parts to Company D. Each part has a different primary data share and contribution to the absolute value total PCF of the part of Company D (cf. Figure15). According to the formula above, the primary data share of Company D's part is calculated from the primary data share and contributions to the absolute value total PCF (see Figure 15).

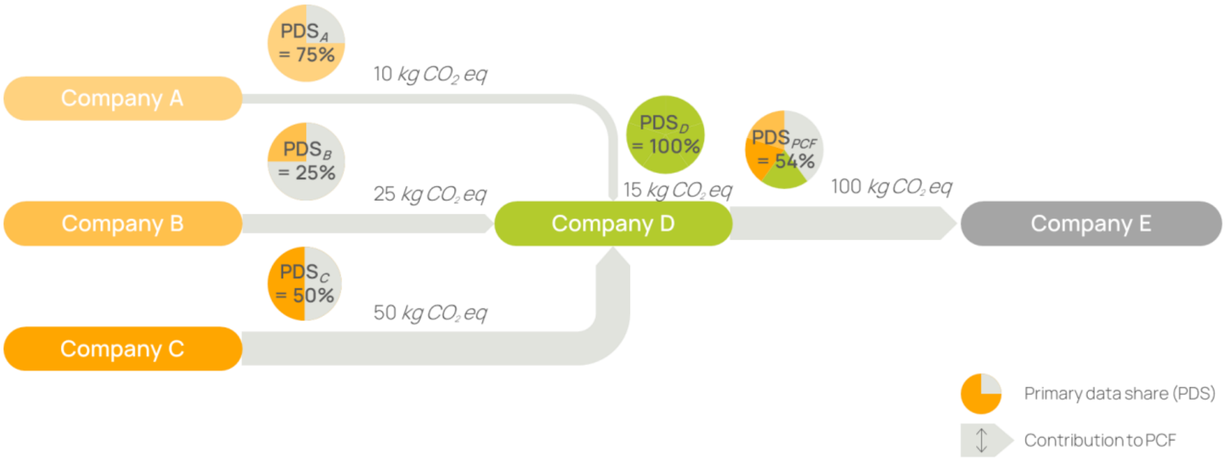


Figure 15: PCF cascade of primary data for an exemplary supply chain

Table 5: Primary data share of the example as in Figure 15

	PDS_i	$PCF_{as,i}$	$PCF_{as,i} \cdot PDS_i$
Company A	75%	$10\ kg\ CO_2\ eq$	$7{,}5\ kgCO_2\ eq$
Company B	25%	$25\ kg\ CO_2\ eq$	$6{,}3\ kg\ CO_2\ eq$
Company C	50%	$50\ kg\ CO_2\ eq$	$25\ kg\ CO_2\ eq$
Company D	100%	$15\ kg\ CO_2\ eq$	$15\ kg\ CO_2\ eq$
Total	**54%**	$\mathbf{100\ kg\ CO_2\ eq}$	$\approx \mathbf{54\ kg\ CO_2\ e}$, $(7{,}5 + 6{,}3 + 25 + 15)\ kg\ CO_2\ eq$

When calculating the primary data share, a contribution to the primary data share shall only be attributed, if both the activity data (e.g., amount in kWh) and the GHG emission factor (expressed in $kgCO_2eq$ per unit) information is derived from primary (Table 5). Supplier data shall only be considered as primary data if declared as such in percentage of primary data share.

Only product- or company-specific data may contribute to the primary data share.

Prospective PCF

A Primary Data Share shall only be provided for retrospective PCFs.

7.2.5 Data quality rating

In Catena-X, companies calculate the product carbon footprint from (compare 5):

1. Primary data owned by the company calculating PCF, i.e., data on processes run by the company,
2. Primary data of third parties in the supply chain, i.e., data on processes not run by the company, but data received from its suppliers,
3. Secondary data sources, i.e., the process is not run by the company and no data is received from its suppliers.

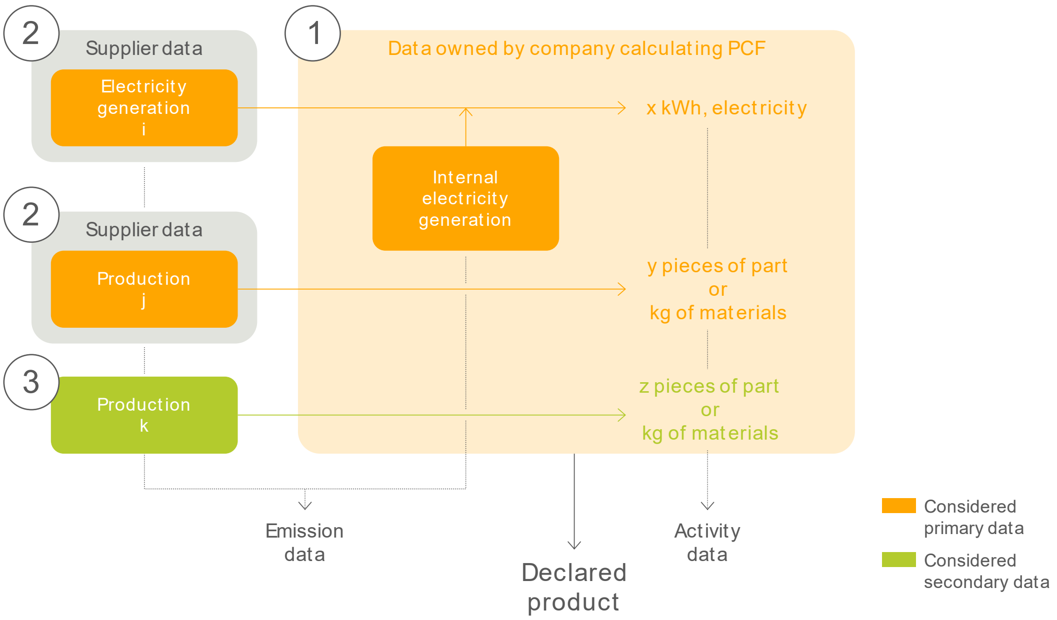


Figure 16: Data sources for PCF calculation

7.2.5.1 Data quality assessment (only valid after transition period)

Starting from mid-2025 an updated PCF Data model will support the here prescribed approach. Previous versions of DQR reporting are discontinued. The data quality rating will be mandatory after the transition period.

During the data collection process, companies shall assess the data quality of activity data, emission factors, and/or direct emissions data by using the data quality ratings (DQR).

Today companies can calculate their Product Carbon footprints (PCFs) with the scope cradle-to-gate using several data types. The quality of data can be significantly different. Therefore, data quality assessments of data used to calculate a PCF provide data users with a better understanding of the overall integrity of the data and the resulting PCF.

The standard defines the three data quality indicators to use in assessing data quality. They are:

- Technological representativeness: the degree to which the data reflects the actual technology(ies) used in the process.
- Geographical representativeness: the degree to which the data reflects actual geographic location of the processes within the inventory boundary (e.g., country or site)
- Temporal representativeness: the degree to which the data reflect the actual time (e.g., year) or age of the process.

Assessing data quality during data collection allows companies to make data quality improvements more efficiently than if data quality is assessed after collection is complete.

Data quality shall be assessed for both primary and secondary data in terms of how well they represent the actual production of the product under study. In the case of secondary data, the data quality rating reported for the original data taken from a database may not be directly used.

Instead, the reported data quality rating should serve as the basis to assess the representativeness of the product under study, i.e., how well the secondary data represents actual production in the supply chain.

The data quality of each PCF shall be calculated and reported. The DQR calculation shall be based on three data quality criteria where TeR is the technological representativeness, TiR is the time/temporal representativeness, GeR is the geographical representativeness, Table 6 shall be used to determine a semi-quantitative data quality rating.

The quality levels are expressed in five categories from 1 (best) to 5 (worst). The representativeness (technological, geographical, and time-related) characterizes the degree to which the processes and products selected depict the system analyzed.

Table 6: Sample scoring criteria for performing a qualitative data quality assessment

	1	2	3	4	5
Technology Representa-tiveness (TeR)	The dataset has been created based on data reflecting the exact technology employed (i.e. plant specific process/equipment data for the plant/equipment where the product has been manufactured) Explanation: this quality score can be achieved only in case of use of primary data	The dataset has been created based on data reflecting the company-specific and same technology to the one employed for the actual manufacturing (i.e. same technology, the company/site specific but not necessarily plant specific – it could be an average if several company/site specific data are available) Explanation: this quality score can be achieved only in case of use of primary data	The dataset has been created based on data reflecting an average for an equivalent technology to the one employed for the actual manufacturing (i.e. same technology, but not company specific) Explanation: this is the maximum score achievable with secondary data	The dataset has been created based on data reflecting a technological proxy (i.e. similar but not same technology, irrespectively if based on averages or supplier specific data)	The dataset has been created based on different or unknown technology vs technology actually employed
Time/temporale Representativeness (TiR)	The difference between “Reference Period End” of the dataset and “Date of Issue” of the	The difference between “Reference Period End” of the dataset and “Date of Issue” of the	The difference between “Reference Period End” of the dataset and “Date of Issue” of the	The difference between “Reference Period End” of the dataset and “Date of Issue” of the	The difference between “Reference Period End” of the dataset and “Date of Issue” of the

	1	2	3	4	5
	PCF is ≤1 year (i.e. 366d (to count for leap year))	PCF is >1 year and ≤2 years (i.e. 731d)	PCF >2 years and ≤3 years (i.e. 1096d)	PCF is >3 years and ≤4 years (i.e. 1461d)	PCF is >4 years
Geographical Representa-tiveness (GeR)	The dataset has been created based on data reflecting the country subdivision in which the product has been manufactured Example for country subdivision: Provinces in China, States in the US, applicable for bigger countries	The dataset has been created based on data pertaining the country, in which the product has been manufactured The area where the dataset is generated is valid for the geographical area where the site is located Example 1: The site is in California and the dataset is a US average.	The dataset has been created based on data pertaining the geographical region (e.g. Europe, Asia, N. America), in which the product has been manufactured The area where the dataset is generated is valid for the geographical area where the site is located. Example 1: The site is in Spain and the dataset is a European average	The dataset has been created based on global averages Example: The site is in Japan and the dataset is a global average	The dataset has been created based on data with a geographical scope which is either unknown or pertaining a country, or region not including the site in which the product has been manufactured Example 1: In absence of a global average, the dataset geographical applicability is unknown. Example 2: The site is in Mexico, but the dataset is a US average, or a Finnish average or an Asian average or a European average

The data quality shall be propagated through the supply chain in the same manner as the primary data share (PDS). If no DQR is reported, the values representing the lowest data quality as per the sample scoring criteria in Table 6 will be propagated as a default. Therefore, the lowest rating has either the meaning of the lowest data quality or that no data quality rating has been reported.

Prospective PCF

A DQR shall only be provided for retrospective PCFs.

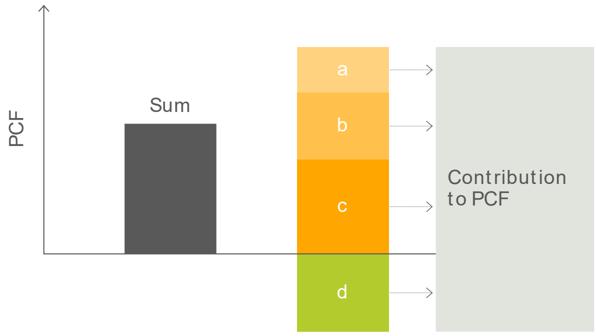
7.2.5.2 Aggregated Data Quality Rating

Each data quality indicator of the PCF (technical, temporal, and geographical) shall be calculated as a weighted mean with the absolute total product carbon footprint excl. bio contribution as weight:

Accounting for uptake of biogenic or fossil emissions with a characterization factor of -1 kg CO_2eq per kg CO_2 can lead to negative PCF contributions. Thus, the sum of the PCF can be lower than the positive contributions to the PCF (Figure 17). When calculating an aggregated DQR, negative contributions would lead to erroneous calculation of the data quality rating.

Hence, to calculate the PDS and DQR absolute values of the PCF, the following formula shall be used:

$$DQR_{aggregated} = \frac{\sum_i (|PCF_i| \cdot DQR_i)}{\sum_i PCF_{as,i}}$$



Contribution	PCF	DQR	PDS
a	1.00	1.00	0.90
b	1.50	2.00	0.70
c	2.00	2.00	0.80
d	-1.75	2.70	0.30
Results	w/o correction	1.20	1.10
	w/ correction	2.00	0.65

Figure 17: Calculation of an aggregated DQR

7.2.6 Reporting carbon offsets

Sharing PCF data across the Catena-X network requires the full PCF (cradle-to-gate) to be shared. Any GHG offsets (such as defined in the glossary) shall be excluded from the reported PCF.

If applicable, the supplier delivering a PCF to a customer shall report any offsets separately from the PCF. This includes both offsets with and without certificates. If carbon offsets have been purchased, they shall transparently mention the origin of reported carbon offsets and refer to the original certificate.

For rules on taking a renewable electricity certificate into account, refer to section 5.2.6.

Any carbon-neutrality claims based on carbon offsetting for parts and components are out of the scope of this PCF rulebook.

Annex

A 1. Additional guidance on classifying waste vs co-product

'Deliberately produced' means that the manufacturing process directly seeks to produce the material/component, i.e. is the result of a technical choice.

'Further use is certain' means that it is not a mere possibility but a certainty; in other words, it is guaranteed that the material will be used. This criterion may be indicated through, for example:

- Existence of contracts between the material producer and subsequent user
- A financial gain for the material producer
- A solid market (sound supply and demand) existing for this further use
- Evidence that the material fulfils the same specifications as other products on the market

'Used directly without any further processing other than normal industrial practice' means that if a production residue has to be treated before it can be used, this may indicate a waste treatment operation. Those treatment techniques that address typical waste-related characteristics of the production residue, such as its contamination with components which are hazardous or not useful, would prevent classification as non-waste. On the other hand, a treatment which is normal industrial practice, e.g. modification of size or shape by mechanical treatment, does not prevent the production residue from being regarded as a by-product.

'Normal industrial practice' can include all steps which a producer would take for a product, such as the material being filtered, washed, or dried; or adding materials necessary for further use; or carrying out quality control. However, treatments usually considered as a recovery operation cannot, in principle, be considered as normal industrial practice in this sense. Recovery operations are divided into three sub-categories: preparing for re-use, recycling, and other recovery.

'Produced as an integral part of a production process' means that the process where the co-product is generated has to be an integral part of a production process. Therefore, a material, which is made ready for further use through an integral part of a production process, can be regarded as a co-product. If a material leaves the site or factory where it is produced in order to undergo further processing, this may be evidence that such tasks are no longer part of the same production process, thus disqualifying it as a co-product.

'Further use is lawful' means that the further use of the material must be lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements at the national level for the specific use and will not lead to overall adverse environmental or human health impacts.

Source for Annex: European Commission (2012): Guidance on the interpretation of key provisions of Directive 2008/98/EC on waste.[7]

[7] https://ens.dk/sites/ens.dk/files/Affald/guidance_on_the_interpretation_of_key_provisions_on_waste.pdf

A 2. Overview of sectoral guidance acceptance in Catena-X

This document provides additional rules for the calculation of product carbon footprints (PCFs) using accepted sectoral guidelines while ensuring compliance with the methodological principles set out in this document.

Currently, the below listed sectoral guidelines have been accepted by Catena-X and may be used to calculate PCFs for Catena-X reporting purposes. These sectoral guidelines may only be used for reporting in the Catena-X network when fulfilling the additional requirements stated in this document with further recommendations that should be complied with. Fulfilling these additional requirements will ensure compliance with the rules in CX-PCF by resolving the divergences between CX-PCF and the accepted sectoral guidelines.

If particular production steps in the value chain are not covered by the currently accepted sectoral guidelines, the CX-PCF rules shall be applied. As shown in Figure 18 this is currently the case for, e.g., certain component producers. Catena-X seeks to accept sectoral guidelines for the remaining white spots going forward.

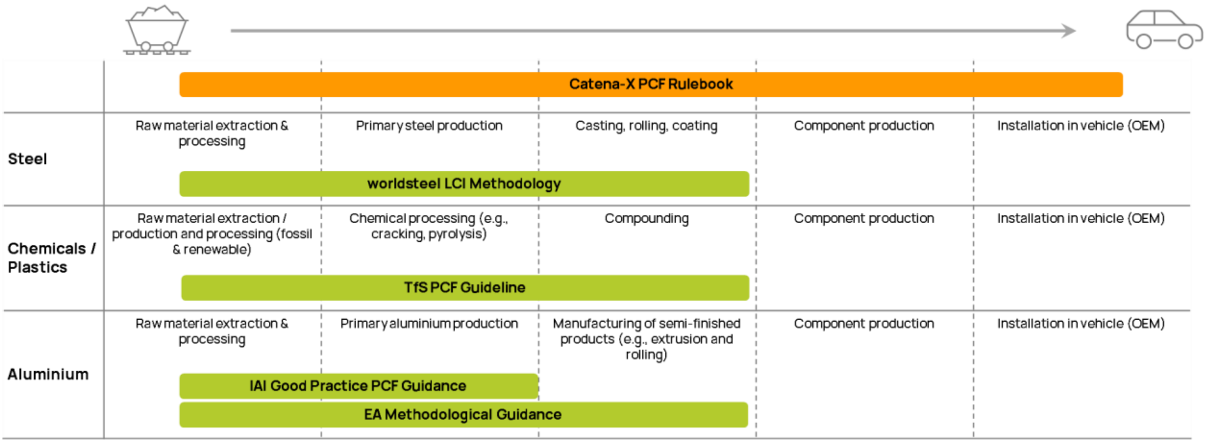


Figure 18: Coverage of accepted sectoral guidelines mapped to the automotive supply chain

Accepting sectoral guidelines requires a detailed mapping of the respective sectoral guideline to CX-PCF rules to identify and classify methodological differences as well as an extensive alignment process with sectoral stakeholders to derive resolutions for all methodological divergences. Catena-X plans to publish more details on this acceptance process in a separate document.

Steel

- **World Steel Association (worldsteel) (2017)**: Life cycle inventory methodology report for steel products (2017 update). URL.

Aluminum

- **International Aluminum Institute (IAI) (2021)**: Good Practice Guideline for Calculation of Primary Aluminum and Precursor Product Carbon Footprints (v2.0). URL.
- **European Aluminum (EA) (2023)**: Methodological Guideline for the Environmental Assessment of Aluminum Intermediate and Semi-Finished Products (Rev. 8). URL.

Chemicals

- **Together for Sustainability (TFS) (2022)**: The Product Carbon Footprint Guideline for the Chemical Industry - Specification for product Carbon Footprint and Corporate Scope 3.1 Emission Accounting and Reporting (Version 3.0). URLs.

Catena-X acknowledges that further sector- or material-specific PCF methodologies and standards exist. Catena-X prioritized the worldsteel, IAI, EA and TFS methodologies as accepted sectoral guidelines due to their high relevance in the automotive value chain in terms of PCF contribution and broad adoption in practice. Going forward, further sectoral guidelines will be considered for acceptance by Catena-X. Only the above-specified versions of the guidelines have been accepted. Acceptance of any updates to the specified versions of the guidelines generally requires a re-assessment by Catena-X.

For each accepted sectoral guideline, annexes 3-6 provide tables that describe the divergences between CX-PCF rules and the respective accepted sectoral guideline, as well as additional requirements that shall or should be applied to ensure compliance with CX-PCF rules (i.e., additional requirements ("shall") or recommendations ("should") when using the respective sectoral guideline). Where no additional requirement or recommendation is provided in this chapter, following the sector methodology can be considered as being compliant with CX-PCF rules. During the creation of Version 4 of the CX-PCF rulebook, also a new version of the TFS PCF guideline was in preparation and a majority of discovered discrepancies has been resolved in a joint effort. Annex A 4 only shows remaining divergences between CX-PCF and the TFS guideline.

Catena-X strives to minimize the need for additional requirements and closely engages with sector representatives throughout the sectoral guideline acceptance process and beyond.

A process for further sector guideline acceptance will be implemented by the Catena-X Association going forward and made available upon request to sustainability@catena-x.net as soon as it has been fully established.

A 3. Additional requirements for users of the worldsteel LCI methodology (2017)

Table 7 provides additional requirements for the worldsteel LCI methodology that shall be applied as accepted sectoral guideline for Catena-X compliance. It describes the divergences and additional requirements. The additional requirements presented in Table 7 shall be followed by companies reporting in CX until further notice and independent of the transition period that CX-PCF defines (except if explicitly mentioned otherwise).

Table 8 provides information on methodological differences that are classified as additional recommendations that should be followed.

The additional requirements in Table 7, as well as the recommendations in Table 8 are based on the version of the worldsteel methodology that is specified in Annex A 3 of this document. Once a new version is available, both tables will be updated as soon as possible.

Table 7: Additional requirements for User of the worldsteel LCI methodology that shall be applied for CX compliance

PCF topic	Chapter in worldsteel	Chapter in CX-PCF	Methodological divergence	Additional requirement for Catena-X reporting
Allocation of multi-functionality	3.6.1 Co-products	5.1.2 Allocation	worldsteel does not prescribe the ISO 14067 allocation hierarchy that shall be followed by CX-PCF and instead applies system expansion as the default methodology to all co-products. No further requirements for applying system expansion are prescribed by worldsteel.	Since subdivision is not possible for typical co-products in the steel industry, applying system expansion is compatible with the CX-PCF hierarchy. However, the requirements for applying system expansion set out by CX-PCF in section 5.1.2 shall be fulfilled. The customer of the co-product can be provided a PCF of the co-product. This enables the customer of the co-product to account for the co-product's correct footprint and prevents double counting of credits. Companies shall refer to the worldsteel Life cycle inventory (LCI) study 2020 data release table "Appendix 8: System expansion assumptions" for choosing dominant, identifiable displaced product and production paths for applying system expansion.
Accounting for waste treatment	3.5.5 Waste for disposal	5.2.4 Accounting for waste treatment	worldsteel classifies "materials exported from the site for external applications" as co-products, while CX-PCF prescribes a classification hierarchy that shall be followed and classifies pre-consumer scrap by default as waste.	The requirements in CX-PCF chapter 5.2.4 shall be followed: waste shall be classified following the CX-PCF waste versus co-product classification hierarchy. Pre-consumer scrap (excluding runaround scrap) shall be classified as waste and thereby cut-off allocation shall

PCF topic	Chapter in worldsteel	Chapter in CX-PCF	Methodological divergence	Additional requirement for Catena-X reporting
				be applied unless legal evidence exists for classifying pre-consumer scrap as co-product.
Accounting for waste treatment	N/A	5.2.4 Accounting for waste treatment	While CX-PCF requires the polluter pays approach for energy recovery, worldsteel does not provide specific guidance on waste-to-energy allocation.	The CX-PCF requirements on waste-to-energy modelling shall be applied (i.e., polluter pays principle) (chapter 5.2.4). The general practice in the automotive industry is following the polluter pays principle, i.e., allocating waste treatment emissions to the product system generating the waste. Hence, recovered energy from automotive waste is emission-free in the product system using it.
Recycling approach (material)	3.6.2 Steel Scrap	5.2.5 Accounting for recycling (within the transition period)	For cradle-to-gate LCI datasets, there is compliance between CX-PCF's and worldsteel's cradle-to-gate approaches as no substitution credits are involved and preparatory steps are included. However, worldsteel does not explicitly prescribe the cut-off allocation for users of the guideline. Still in worldsteel's cradle-to-gate scope, applying the cut-off approach is common practice in worldsteel.	The cut-off approach shall be applied (refer to material recycling section 5.2.5 in CX-PCF).
Electricity and energy modelling	3.3.2 Geographic coverage; 3.5.2 Fuels and energy – upstream data	5.2.6 Accounting for GHG emissions from electricity	While CX-PCF requires a market-based approach in regions where residual grid mixes are available, worldsteel prescribes the location-based approach for electricity modelling.	For electricity modelling, the CX-PCF market-based modelling requirements in chapter 5.2.6 shall be followed. The market-based modelling approach shall be applied where residual grid mixes are available and issuing bodies oversee the issuance of electricity instruments (e.g. AIB). Only in regions where contractual instruments and residual grid mixes are not available, grid-specific consumption mixes shall be used while contractual instruments are not allowed (i.e., a location-based approach).

PCF topic	Chapter in worldsteel	Chapter in CX-PCF	Methodological divergence	Additional requirement for Catena-X reporting
Scope and system boundaries	3.3 System boundaries	4. 2 System boundaries	worldsteel allows both a “cradle-to-gate” and a “cradle-to-gate with recycling” scope, while CX-PCF only allows the cradle-to-gate scope.	worldsteel users shall follow the “cradle-to-gate” scope (not “cradle-to-gate with recycling”).
Cut-off criteria and threshold	3.5.8 Cut-off criteria	4.3 Cut-off rules	CX-PCF prescribes a cut-off threshold of 3% based on the total carbon footprint of the reporting company’s system boundary identified in a screening study. worldsteel prescribes a cut-off threshold of 3% based on mass, energy, or environmental relevance for each unit process and the sum of excluded material flows must not exceed 5%.	Cut-off rules may diverge (e.g., based on mass or energy rather than PCF) if achieving a high coverage (i.e. 97%) of the total PCF based on a screening analysis. To determine the 97% coverage, the PCF data received from suppliers and emission factors shall be considered as 100% for practicality reasons. The underlying screening analysis shall be compliant with CX-PCF section 4.3. worldsteel may publish representative studies which may be used by companies instead of individual screening analyses. Until these are available, a company-specific screening analysis shall be provided.
Characterization factors	n/a	4.1 Focus on carbon footprint	While the latest IPCC characterization factors are currently used in worldsteel’s modelling, the LCI methodology does not include explicit specifications for reporting companies.	The 100-year GWP characterization factors (GWP100y) according to the latest Intergovernmental Panel on Climate Change (IPCC) Assessment Report (AR) shall be used (currently AR6; see CX-PCF chapter 4.1)
Separate reporting in line with ISO 14067	n/a	4.1 Focus on carbon footprint & Accounting for carbon uptake (biogenic or fossil)	worldsteel does not explicitly mention accounting and reporting of biogenic emissions and removals, while CX-PCF requires separate reporting of biogenic emissions following a specified accounting approach (-1/+1 approach).	The CX-PCF requirements for accounting and reporting of biogenic emissions in chapter 4.1 shall be followed.
Chain of custody principles	n/a	5.2.7 Accounting for Chain of Custody models	The worldsteel LCI methodology does not include provisions on using chain of custody models for product carbon footprint accounting.	The set of principles prescribed by CX-PCF in 5.2.7 shall be followed if chain of custody models are applied for PCF accounting.
Data requirements	3.3.3 Time coverage; 3.5.7 Data quality requirements	7.2.2 Temporal validity	While CX-PCF prescribes an annual data check, worldsteel prescribes a validity period of five years for primary and ten years for secondary data.	Reporting companies are encouraged to submit data with high temporal validity and required to perform data updates if the PCF increases by 10% or more based on the screening analysis compared to the previous reporting period as defined in section 7.2.2 of CX-PCF.

Table 8: Further guidance that should be followed (recommendations)

PCF topic	Chapter in worldsteel	Chapter in CX-PCF	Methodological divergence	Recommendation for Catena-X reporting
Accounting for waste treatment	3.5.5 Waste for disposal	5.2.4 Accounting for waste treatment	While CX-PCF prescribes the use of primary data for waste modelling, worldsteel models waste as an input into a generic conservative waste landfill process.	In line with CX-PCF chapter 5.2.4, waste treatment emissions should be calculated using primary data regarding the type of waste, its composition, and type of waste treatment activity. Depending on the type of waste treatment (for example landfill or incineration), companies may use waste treatment emission factors based on internal primary data. If no primary emission factors are available, emission factors derived from accepted secondary databases can be employed (section 6.1).
Scope and system boundaries	1.3.2 Applicable products	4.2 System boundaries	worldsteel does not explicitly mention the inclusion of packaging emissions.	In general, packaging emissions may only be excluded under CX-PCF cut-off rules (i.e., packaging might be cut-off if its impact is below prescribed threshold based on a screening analysis). CX-PCF cut-off rules (chapter 4.3) should be followed for packaging emissions.
Separate reporting in line with ISO 14067	N/A	4.1 Focus on carbon footprint	IAI does not specify separate reporting requirements for carbon footprints of aluminum products in line with ISO 14067.	The separate reporting requirements in line with ISO 14067 as per CX-PCF section 4.1 should be applied in compliance with the CX data model.
Separate reporting in line with ISO 14067	n/a	4.1 Focus on carbon footprint; 7.2.6 Reporting offsets	Reporting of carbon offsets is not explicitly mentioned in worldsteel. CX-PCF requires excluding carbon offsets from the calculation of the reported PCF. Further, carbon offsets shall be reported separately (if applicable).	The CX-PCF requirements for reporting carbon offsets in chapters 4.1 and 7.2.6 should be applied.
Transport emissions modelling	3.5.1 Transport	5.2.3 Accounting for transportation emissions	CX-PCF prescribes a hierarchical approach for transportation modelling, from measuring fuel and energy use as first priority to calculating emissions based on estimated values (e.g., using EcoTransIT). worldsteel only requires	No divergence as CX-PCF hierarchy allows transport modelling prescribed by worldsteel. However, CX recommends to follow the CX-PCF transport hierarchy for more accurate modelling of transport emissions if possible and relevant (chapter 5.2.3).

PCF topic	Chapter in worldsteel	Chapter in CX-PCF	Methodological divergence	Recommendation for Catena-X reporting
			information on distance travelled and type of transportation.	
Transport emissions reporting	3.5.1 Transport	5.2.3 Emissions from transportation	CX-PCF requires that the customer quantifies the transport emissions if the customer contracts or operates inbound transportation. If the supplier contracts or operates outbound transportation to the customer, the supplier shall report transport emissions separately (such that the customer can account for the emissions). worldsteel does not require a similar "one down" approach.	For reporting transportation emissions between supplier and customer, CX-PCF section 5.2.3 should be followed.
Data requirements	3.5.7 Data quality requirements	6. Data sources and hierarchy	CX-PCF generally follows a "primary data first" principle, while worldsteel prescribes primary data for gate-to-gate processes ("Primary data is to be used for gate-to-gate production processes") and recommends primary data for up- and downstream processes ("primary data should be utilized for upstream and downstream processes if possible").	Companies are encouraged to collect upstream primary data (i.e. supplier-specific PCF values). The Primary Data Share (PDS) and Data Quality Rating (DQR) will reflect potential data shortcomings.
Primary Data Share (PDS)	n/a	7.2.4 Primary data share	worldsteel does not explicitly require the calculation and reporting of a PDS while CX-PCF does.	The PDS as set out in CX-PCF chapter 7.2.4 should be calculated and reported taking into consideration the primary data definition and additional guidance as provided in CX-PCF chapter 6 and additional guidance documents. Note that the PDS will be set to zero (i.e., the most conservative value) if no PDS is submitted. The PDS data field in the Catena-X data model will become mandatory only after the CX-PCF transition period. Hence, this might become a "shall" requirement in the future.
Data Quality Rating (DQR)	n/a	7.2.5 Data quality rating	While similar data categories shall be taken into consideration in LCI data collection, worldsteel does not explicitly require assessing a data quality rating (DQR).	The DQR as set out in CX-PCF chapter 7.2.5 should be calculated and reported. Note that the DQR will be set to the most conservative value if no DQR is being submitted.

PCF topic	Chapter in worldsteel	Chapter in CX-PCF	Methodological divergence	Recommendation for Catena-X reporting
				The DQR data field in the Catena-X data model will become mandatory only after the CX-PCF transition period. Hence, this might become a “shall” requirement in the future.

A 4. Additional requirements for users of the Together for Sustainability PCF Guideline (2024)

Table 9 provides additional requirements for the Together for Sustainability (TFS) PCF Guideline for the Chemical Industry that shall be applied as accepted sectoral guideline for Catena-X compliance. It describes the divergences and additional requirements. The additional requirements presented in Table 9 shall be followed by companies reporting in CX until further notice and independent of the transition period that CX-PCF defines (except if explicitly mentioned otherwise).

Table 9: Additional requirements for Users of the TFS PCF Guideline that shall be applied for CX compliance

PCF topic	Chapter in TFS	Chapter in CX-PCF	Methodological divergence	Additional requirement for Catena-X reporting
Allocation of multi-functionality	5.2.9.3 Allocation rules	5.1.2 Allocation	TFS recommends calculating the the factor "based on stable market prices, as a yearly average or over multiple years in case of high fluctuation (e.g. >100%) of prices to average out high fluctuations of prices" rather than requiring averaging of at least 3 years as in CX-PCF.	The chosen economic allocation factor (prices) shall always be averaged at least over the last 3 years to smooth out fluctuations.
Accounting for waste treatment	5.2.8.4 Waste treatment and recycling	5.2.4 Accounting for waste treatment	TFS allows cut-off, reverse cut-off and substitution approaches for modelling waste-to-energy processes. CX-PCF prescribes the "polluter pays principle", which corresponds to the reverse cut-off approach in TFS.	In order to comply with CX's polluter pays principle, TFS users shall follow the reverse cut-off approach for waste-to-energy allocation. The general practice in the automotive industry is following the polluter pays principle, i.e., allocating waste treatment emissions to the product system generating the waste. Hence, recovered energy from automotive waste is emission-free in the product system using it. Catena-X is aware, that this approach is not recommended by GHG protocol.
Recycling approach (material)	5.2.8.4 Waste treatment and recycling	5.2.5 Accounting for recycling (within the transition period)	TFS prescribes the cut-off approach by default and allows Upstream System Expansion (USE) to be used instead of cut-off for exceptional cases (chemical recycling) if certain requirements are fulfilled. CX prescribes the cut-off approach as the default allocation approach.	The cut-off approach shall be applied for recycling for the calculation of the final PCF value in line with CX-PCF chapter 5.2.5. Other approaches may be prescribed or allowed after the transition period, as stated in chapter 5.2.5.

PCF topic	Chapter in TFS	Chapter in CX-PCF	Methodological divergence	Additional requirement for Catena-X reporting
Allocation of multi-functionality	5.2.9.1 Substitution	5.1.2 Allocation	The requirements for applying system expansion and substitution in CX-PCF and TFS are broadly aligned, but CX-PCF provides explicit data requirements and recommends a PCF statement for co-products that are sold, if system expansion substitution is applied.	The requirements for applying system expansion set out by CX-PCF in chapter 5.1.2 shall be fulfilled. The customer of the co-product can be provided a PCF of the co-product. This enables the customer of the co-product to account for the co-product's correct footprint and prevents double counting of credits.
Chain of custody principles	4.6.7 Mass-balance chain-of-custody	5.2.7 Accounting for chain of custody models	In principle, the Chain of Custody requirements are aligned with TfS. However, the specific criteria for applying mass balance diverge in some specifications (e.g. additionality).	The set of principles prescribed by CX-PCF in 5.2.7 shall be followed if chain of custody models are applied for PCF accounting.
Data requirements	5.2.2 Temporal Scope	7.2.2 Temporal validity	CX-PCF requires an update of the reported PCF if the reported PCF increases by 10% or more based on an annually checked screening study, while TfS allows up to 20% and requires an update of the PCF after three years.	Reporting companies are encouraged to submit data with high temporal validity and required to perform data updates if the PCF increases by 10% or more based on the screening analysis compared to the previous reporting period as defined in section 7.2.2 of CX-PCF.

Once new versions of the TFS Guideline becomes available, Table 9 may be updated to reflect the latest methodology developments and further alignments between CX and TFS standards.

A 5. Additional requirements for users of the methodology published by European Aluminum (2023)

Table 10 provides additional requirements for the European Aluminum (EA) methodology that shall be applied as accepted sectoral guideline for Catena-X compliance. It describes the divergences and additional requirements. The additional requirements presented Table 10 shall be followed by companies reporting in CX until further notice and independent of the transition period that CX-PCF defines (except if explicitly mentioned otherwise).

Table 11 provides information on methodological differences that are classified as additional recommendations that should be followed.

Note that the additional requirements in Table 10 as well as the recommendations in Table 11 are based on the version of the EA methodology that is specified in the introduction of this document. Once a new version is available, both tables will be updated as soon as possible.

Table 10: Additional requirements for companies using the EA methodology that shall be applied for CX compliance

PCF topic	Chapter in EA	Chapter in CX-PCF	Methodological divergence	Additional requirement for CX reporting
Allocation of multi-functionality	11.1. Allocation in the alumina production process	5.1.2 Allocation	EA prescribes physical allocation based on mass for the alumina refining process step. However, no allocation is needed as smelter- and non-smelter-grade alumina are not co-products of the same process but produced separately.	In line with the CX-PCF allocation hierarchy (chapter 5.1.2), process sub-division shall be applied in the alumina refining process step.
Allocation of multi-functionality	11.5. Allocation at salt slag/SPL recycling	5.1.2 Allocation	Salt slag recycling: EA prescribes closed-loop modelling in case of in-house recycling. If salt slag is exported for recycling, it is usually treated as waste and cut-off is applied at the aluminum producer. At the recycler, economic allocation is recommended by EA.	If salt slag is recycled externally, companies shall apply the cut-off allocation for salt slag at the secondary aluminum producer (as waste recovered by recycling) and economic allocation at the recycler of salt slag, provided that the price differential is in line with CX requirements outlined in chapter 5.1.2.
Accounting for waste treatment	2. Glossary	5.2.4 Accounting for waste treatment	EA uses a scrap typology coupled with the process stage where scrap originates from to classify waste vs. co-product, while CX-PCF classifies pre-consumer scrap by default as waste (based on the EU Waste Framework Directive interpretation).	Pre-consumer scrap (excluding runaround scrap) shall be classified as waste and thereby cut-off allocation shall be applied unless legal evidence exists for classifying pre-consumer scrap as co-product. The requirements in CX-PCF chapter 5.2.4 shall be followed.
Recycling approach (material)	11. Allocation rules	5.2.5 Accounting for recycling	For post-consumer scrap, EA prescribes the cut-off approach. However, EA allows different allocation approaches for	The requirements in CX-PCF chapter 5.2.5 shall be followed: waste shall be classified following the CX-PCF waste versus co-product classification

PCF topic	Chapter in EA	Chapter in CX-PCF	Methodological divergence	Additional requirement for CX reporting
			modelling pre-consumer scrap, while CX-PCF prescribes cut-off approach (since pre-consumer scrap is classified as waste unless legal evidence exists for co-product classification).	hierarchy Pre-consumer scrap (excluding runaround scrap) shall be modelled using the cut-off approach if recovered by recycling following chapter 5.2.5 unless legal evidence exists for classifying pre-consumer scrap as co-product. In the latter case, CX-PCF allocation rules outlined in chapter 5.1.2 shall apply.
Electricity and energy modelling	12.6.1 Location-based approach for electricity modelling	5.2.6 Accounting for GHG emissions from electricity	While CX prescribes a market-based approach where residual grid mixes are available, EA allows both the location-based and the market-based approach for electricity modelling (with the market-based modelling being broadly aligned).	For electricity modelling, the CX-PCF market-based modelling requirements in chapter 5.2.6 shall be followed. The market-based modelling approach shall be applied where residual grid mixes are available and issuing bodies oversee the issuance of electricity instruments (e.g. AIB). Only in regions where contractual instruments and residual grid mixes are not available, grid-specific consumption mixes shall be used while contractual instruments are not allowed (i.e., a location-based approach).
Cut-off criteria and threshold	10. Cut-off rules	4.3 Cut-off rules	While CX prescribes a cut-off threshold of 3% based on the total carbon footprint of the reporting company's system boundary, EA prescribes a cut-off threshold of 3% based on mass and energy per unit process and the sum of excluded material flows must not exceed 3%.	Cut-off rules may diverge (e.g., based on mass or energy rather than PCF) if achieving a high coverage (i.e. 97%) of the total PCF based on a screening analysis. To determine the 97% coverage, the PCF data received from suppliers and emission factors shall be considered as 100% for practicality reasons. The underlying screening analysis shall be compliant with CX-PCF section 4.3. EA may publish representative studies which may be used by companies instead of individual screening analyses. Until these are available, a company-specific screening analysis shall be provided.
Characterization factors	13. Impact categories and	4.1 Focus on carbon footprint	CX-PCF currently requires the use of the latest 100-year GWP characterization factors (GWP100y) according to the latest	The 100-year GWP characterization factors (GWP100y) according to the latest Intergovernmental Panel on Climate Change

PCF topic	Chapter in EA	Chapter in CX-PCF	Methodological divergence	Additional requirement for CX reporting
	resource indicators		Intergovernmental Panel on Climate Change (IPCC) Assessment Report 6 (AR6). EA refers to characterization factors from IPCC 2013 (AR5).	(IPCC) Assessment Report (AR) shall be used (currently AR6; see CX-PCF chapter 4.1)
Chain of custody principles	n/a	5.2.7 Accounting for Chain of Custody models	The EA methodology does not include provisions on using chain of custody models for product carbon footprint accounting.	The set of principles prescribed by CX-PCF in 5.2.7 shall be followed if chain of custody models are applied for PCF accounting.
Data requirements	9. Data collection & data requirements	7.2.2 Temporal validity	CX prescribes an annual data check, EA recommends it.	Reporting companies are encouraged to submit data with high temporal validity and required to perform data updates if the PCF increases by 10% or more based on the screening analysis compared to the previous reporting period as defined in section 7.2.2 of CX-PCF.

Table 11: Further guidance that should be followed (recommendations)

PCF topic	Chapter in EA	Chapter in CX-PCF	Methodological divergence	Recommendation for CX reporting
Allocation of multi-functionality	11. Allocation rules	5.1.2 Allocation	CX-PCF prescribes an allocation hierarchy for co-product allocation based on ISO 14067, while EA prescribes process-specific allocation procedures.	In multi-output allocation cases that are not covered by EA and where room for interpretation remains, the CX-PCF allocation hierarchy based on ISO 14067 should be followed.
Accounting for waste treatment	11. Allocation rules	5.2.4 Accounting for waste treatment	EA implements energetic closed-loop modelling for waste-to-energy processes, while CX-PCF prescribes the polluter pays principle.	Due to low relevance in the aluminum sector, Catena-X recommends (rather than requires) to use the polluter pays principle for waste-to-energy allocation according to CX-PCF chapter 5.2.4.
Scope and system boundaries	8. Life cycle stages	4.2 System boundaries	EA prescribes the inclusion of distribution packaging emissions only if their contribution to the overall PCF is deemed relevant and requires excluding packaging of raw materials used.	Packaging emissions may only be excluded under CX-PCF cut-off rules (i.e., packaging might be cut-off if its impact is below prescribed threshold based on a screening analysis). CX-PCF cut-off

PCF topic	Chapter in EA	Chapter in CX-PCF	Methodological divergence	Recommendation for CX reporting
				rules (chapter 4.3) should be followed for packaging emissions.
Transport emissions modelling	12.5. How to model transport of raw materials and semi-finished products	5.2.3 Accounting for transportation emissions	CX-PCF prescribes a hierarchical approach for transportation modelling, from measuring fuel and energy use as first priority to calculating emissions based on estimated values (e.g., using EcoTransIT). EA also prescribes a hierarchical approach, which prioritizes primary data, followed by default scenarios.	CX-PCF hierarchy allows transport modelling prescribed by EA. However, CX recommends to follow the CX-PCF transport hierarchy for more accurate modelling of transport emissions if possible and relevant (chapter 5.2.3).
Transport emissions reporting	12.5. How to model transport of raw materials and semi-finished products	5.2.3 Emissions from transportation	CX-PCF requires that the customer quantifies the transport emissions if the customer contracts or operates inbound transportation. If the supplier contracts or operates outbound transportation to the customer, the supplier shall report transport emissions separately (such that the customer can account for the emissions). EA does not require a similar “one down” approach.	For reporting transportation emissions between supplier and customer, CX-PCF section 5.2.3 should be followed.
Separate reporting in line with ISO 14067	n/a	4.1 Focus on carbon footprint	EA does not specify separate reporting requirements for carbon footprints of aluminum products in line with ISO 14067.	The separate reporting requirements in line with ISO 14067 as per CX-PCF section 4.1 should be applied in compliance with the CX data model.
Separate reporting in line with ISO 14067	N/A	4.1 Focus on carbon footprint; 7.2.6 Reporting offsets	CX-PCF requires excluding offsets as well as avoided emissions from the reported PCF. Further, offsets shall be reported separately (if applicable) and avoided emissions shall not be reported. EA does not include requirements on separate reporting of avoided emissions and offsets.	It is recommended to follow CX-PCF requirements for reporting offsets and avoided emissions in chapter 4.1 and chapter 7.2.6.
Data requirements	9. Data collection & data requirements	6. Data sources and hierarchy	CX-PCF generally follows a “primary data first” principle, while EA defines processes that shall use primary data in Section 8 and recommends using primary data for other processes.	Companies are encouraged to collect upstream primary data (i.e. supplier-specific PCF values). The Primary Data Share (PDS) and Data Quality Rating (DQR) will reflect potential data shortcomings.

PCF topic	Chapter in EA	Chapter in CX-PCF	Methodological divergence	Recommendation for CX reporting
Primary Data Share (PDS)	N/A	7.2.4 Primary data share	EA does not explicitly require the calculation and reporting of a PDS while CX-PCF does.	The PDS as set out in CX-PCF chapter 7.2.4 should be calculated and reported taking into consideration the primary data definition and additional guidance as provided in CX-PCF chapter 6 and additional guidance documents. Note that the PDS will be set to zero (i.e., the most conservative value) if no PDS is submitted. The PDS data field in the Catena-X data will become mandatory only after the CX-PCF transition period. Hence, this might become a "shall" requirement in the future.
Data Quality Rating (DQR)	N/A	7.2.5 Data quality rating	EA does not explicitly require the calculation and reporting of a DQR while CX-PCF does.	The DQR as set out in CX-PCF chapter 7.2.5 should be calculated and reported. Note that the DQR will be set to the most conservative value if no DQR is being submitted. The DQR data field in the Catena-X data model will become mandatory only after the CX-PCF transition period. Hence, this might become a "shall" requirement in the future.

A 6. Additional requirements for users of the methodology published by International Aluminum Institute (2021)

Table 12 provides additional requirements for the International Aluminum Institute (IAI) methodology that shall be applied as accepted sectoral guideline for Catena-X compliance. It describes the divergences and additional requirements. The additional requirements presented in Table 12 shall be followed by companies reporting in CX until further notice and independent of the transition period that CX-PCF defines (except if explicitly mentioned otherwise).

Table 13 provides information on methodological differences that are classified as additional recommendations that should be followed.

Note that the additional requirements in Table 12 as well as the recommendations in Table 13 are based on the version of the IAI methodology that is specified in the introduction of this document. Once a new version is available, both tables will be updated as soon as possible.

Table 12: Additional requirements for companies using the IAI methodology that shall be applied for CX compliance

PCF topic	Chapter in IAI	Chapter in CX-PCF	Methodological divergence	Additional requirement for CX reporting
Allocation of multi-functionality	11.1. Allocation in the alumina production process	5.1.2 Allocation	IAI prescribes physical allocation based on mass for the alumina refining process step. However, no allocation is needed as smelter- and non-smelter-grade alumina are not co-products of the same process but produced separately.	In line with the CX-PCF allocation hierarchy (chapter 5.1.2), process sub-division shall be applied in the alumina refining process step.
Accounting for waste treatment	7.2.3 Primary cast-house products; IAI reference document on scrap flows: Sections 4 – 6	5.2.4 Accounting for waste treatment	IAI classifies waste vs. co-product based on the process stage where scrap originates from, while CX-PCF classifies pre-consumer scrap by default as waste (based on the EU Waste Framework Directive interpretation).	Pre-consumer scrap (excluding runaround scrap) shall be classified as waste and thereby cut-off allocation shall be applied unless legal evidence exists for classifying pre-consumer scrap as co-product. The requirements in CX-PCF chapter 5.2.4 shall be followed.
Accounting for waste treatment	N/A	5.2.4 Accounting for waste treatment	IAI does not provide guidance on waste modelling. Also the IAI Reference document for scrap flow accounting does not prescribe an approach.	IAI users shall follow European Aluminum (EA) methodology on accounting for waste treatment, including the guidance presented in EA tables 4.1 and 4.2 of this document.
Recycling approach (material)	IAI reference document on scrap flows: Section 8.2	5.2.5 Accounting for recycling	For post-consumer scrap, IAI prescribes the cut-off approach. However, IAI allows different allocation approaches for modelling pre-consumer scrap, while CX-PCF prescribes cut-off approach (since pre-	Pre-consumer scrap (excluding runaround scrap) shall be modelled using the cut-off approach if recovered by recycling following chapter 5.2.5 unless legal evidence exists for classifying pre-consumer scrap as co-product. In the latter case,

PCF topic	Chapter in IAI	Chapter in CX-PCF	Methodological divergence	Additional requirement for CX reporting
			consumer scrap is classified as waste unless legal evidence exists for co-product classification).	CX-PCF allocation rules outlined in chapter 5.1.2 shall apply.
Electricity and energy modelling	6.4.1 Selection of Emission Factors	5.2.6 Accounting for GHG emissions from electricity	While CX prescribes a market-based approach While CX prescribes a market-based approach where residual grid mixes are available, IAI prescribes the location-based approach for electricity modelling.	For electricity modelling, the CX-PCF market-based modelling requirements in chapter 5.2.6 shall be followed. The market-based modelling approach shall be applied where residual grid mixes are available and issuing bodies oversee the issuance of electricity instruments (e.g. AIB). Only in regions where contractual instruments and residual grid mixes are not available, grid-specific consumption mixes shall be used while contractual instruments are not allowed (i.e., a location-based approach).
Cut-off criteria and threshold	N/A	4.3 Cut-off rules	While CX prescribes a cut-off threshold of 3% based on the total carbon footprint of the reporting company's system boundary identified in a screening study, IAI does not specify a specific cut-off rule in its guideline. However, according to the IAI (2019) LCI Data and Environmental Metrics, a 1% cut-off threshold per unit process is applied.	Cut-off rules may diverge (e.g., based on mass or energy rather than PCF) if achieving a high coverage (i.e. 97%) of the total PCF based on a screening analysis. To determine the 97% coverage, the PCF data received from suppliers and emission factors shall be considered as 100% doe practicality reasons. The underlying screening analysis shall be compliant with CX-PCF section 4.3. IAI may publish representative studies which may be used by companies instead of individual screening analyses. Until these are available, a company-specific screening analysis shall be provided.
Characterization factors	6.1 Climate change impact category characterization factor	4.1 Focus on carbon footprint	CX-PCF currently requires the use of the latest 100-year GWP characterization factors (GWP100y) according to the latest Intergovernmental Panel on Climate Change (IPCC) Assessment Report 6 (AR6). IAI refers to characterization factors from IPCC 2007 (AR4) in its methodology ("at the time of writing"). Note, though, that IAI	The 100-year GWP characterization factors (GWP100y) according to the latest Intergovernmental Panel on Climate Change (IPCC) Assessment Report (AR) shall be used (currently AR6; see CX-PCF chapter 4.1).

PCF topic	Chapter in IAI	Chapter in CX-PCF	Methodological divergence	Additional requirement for CX reporting
			applies latest AR6 characterization factors in their modelling.	
Chain of custody principles	N/A	5.2.7 Accounting for Chain of Custody models	The IAI methodology does not include provisions on using chain of custody models for product carbon footprint accounting.	The set of principles prescribed by CX-PCF in 5.2.7 shall be followed if chain of custody models are applied for PCF accounting.
Data requirements	6.2 Applicable time series	7.2.2 Temporal validity	CX prescribes an annual data check, IAI requires data updates "whenever a significant change occurs" or "every 5 years".	Reporting companies are encouraged to submit data with high temporal validity and required to perform data updates if the PCF increases by 10% or more based on the screening analysis compared to the previous reporting period as defined in section 7.2.2 of CX-PCF.

Table 13: Further guidance that should be followed (recommendations)

PCF topic	Chapter in IAI	Chapter in CX-PCF	Methodological divergence	Recommendation for CX reporting
Allocation of multi-functionality	7.2 Allocation procedure	5.1.2 Allocation	CX-PCF prescribes an allocation hierarchy for co-product allocation based on ISO 14067, while IAI is prescribing process-specific allocation procedures.	In multi-output allocation cases that are not covered by IAI and where room for interpretation remains, the CX-PCF allocation hierarchy based on ISO 14067 should be followed.
Allocation of multi-functionality	N/A	5.1.2 Allocation	IAI does not provide guidance on the allocation procedure for anode butts, spent pot lining (SPL), coal tar pitch, and petroleum coke.	If allocation for anode butts, spent pot lining (SPL), coal tar pitch, and petroleum coke is applicable for IAI users, European Aluminum (EA) methodology for allocating these processes should be followed, including the requirements and guidance presented in tables 4.1 and 4.2.
Accounting for waste treatment	N/A	5.2.4 Accounting for waste treatment	IAI does not provide guidance on the allocation procedure for waste-to-energy processes, while CX-PCF prescribes the polluter pays principle.	Due to low relevance in the aluminum sector, Catena-X recommends (rather than requires) to use the polluter pays principle for waste-to-energy allocation according to CX-PCF chapter 5.2.4.
Scope and system boundaries	N/A	4.2 System boundaries	IAI does not mention the inclusion of packaging emissions, while CX-PCF	Packaging emissions may only be excluded under CX-PCF cut-off rules (i.e., packaging might be cut-off if its impact is below prescribed threshold

PCF topic	Chapter in IAI	Chapter in CX-PCF	Methodological divergence	Recommendation for CX reporting
			generally includes packaging emissions in the system boundary.	based on a screening analysis). CX-PCF cut-off rules (chapter 4.3) should be followed for packaging emissions.
Scope and system boundaries	Annex C	4.2 System boundaries	In Annex C, IAI includes capital goods, employee commuting, and upstream leased assets. CX excludes such non-product related emissions.	CX-PCF rules on excluding non-product related emissions should be followed as presented in chapter 4.2.
Transport emissions modelling	4.3 System boundary	5.2.3 Accounting for transportation emissions	CX-PCF prescribes a hierarchical approach for transportation modelling, from measuring fuel and energy use as first priority to calculating emissions based on estimated values (e.g., using EcoTransIT). IAI does not prescribe a hierarchical approach and requests the following data from companies to calculate their transport emissions: Transport type, vehicle type, distance, loading rate, number of empty returns.	CX-PCF hierarchy allows transport modelling prescribed by IAI. However, CX recommends to follow the CX-PCF transport hierarchy for more accurate modelling of transport emissions if possible and relevant (CX-PCF chapter 5.2.3).
Transport emissions reporting	N/A	5.2.3 Emissions from transportation	CX-PCF requires that the customer quantifies the transport emissions if the customer contracts or operates inbound transportation. If the supplier contracts or operates outbound transportation to the customer, the supplier shall report transport emissions separately (such that the customer can account for the emissions). IAI does not require a similar “one down” approach.	For reporting transportation emissions between supplier and customer, CX-PCF chapter 5.2.3 should be followed.
Separate reporting in line with ISO 14067	N/A	4.1 Focus on carbon footprint	IAI does not specify separate reporting requirements for carbon footprints of aluminum products in line with ISO 14067.	The separate reporting requirements in line with ISO 14067 as per CX-PCF section 4.1 should be applied in compliance with the CX data model.
Separate reporting in line with ISO 14067	N/A	4.1 Focus on carbon footprint; 7.2.6 Reporting offsets	CX-PCF requires excluding offsets as well as avoided emissions from the reported PCF. Further, offsets shall be reported separately (if applicable) and avoided emissions shall not be reported. IAI does not include	It is recommended to follow CX-PCF requirements for reporting offsets and avoided emissions in chapter 4.1 and chapter 7.2.6.

PCF topic	Chapter in IAI	Chapter in CX-PCF	Methodological divergence	Recommendation for CX reporting
			requirements on separate reporting of avoided emissions and offsets.	
Data requirements	8.2 Data Quality	6. Data sources and hierarchy	CX-PCF generally follows a "primary data first" principle, while IAI recommends using primary data.	Companies are encouraged to collect upstream primary data (i.e. supplier-specific PCF values). The Primary Data Share (PDS) and Data Quality Rating (DQR) will reflect potential data shortcomings.
Primary Data Share (PDS)	N/A	7.2.4 Primary data share	IAI does not explicitly require the calculation and reporting of a PDS while CX-PCF does.	The PDS as set out in in CX-PCF chapter 7.2.4 should be calculated and reported taking into consideration the primary data definition and additional guidance as provided in CX-PCF chapter 6 and additional guidance documents. Note that the PDS will be set to zero (i.e., the most conservative value) if no PDS is submitted. The PDS data field in the Catena-X data model will become mandatory only after the CX-PCF transition period. Hence, this might become a "shall" requirement in the future.
Data Quality Rating (DQR)	N/A	7.2.5 Data quality rating	IAI does not explicitly require the calculation and reporting of a DQR while CX-PCF does.	The DQR as set out in CX-PCF chapter 7.2.5 should be calculated and reported. Note that the DQR will be set to the most conservative value if no DQR is being submitted. The DQR data field in the Catena-X data model will become mandatory only after the CX-PCF transition period. Hence, this might become a "shall" requirement in the future.

A 7. Main contributing companies

BASF SE

BMW AG

Continental Automotive Technologies GmbH

RENAULT GROUP

Robert Bosch GmbH

Schaeffler Group AG

Siemens AG

Stellantis N.V.

thyssenkrupp Steel Europe AG

TÜV SÜD Auto Service GmbH

Volkswagen AG

A 8. Further contributing companies

Thank you very much for your valuable feedback to the CX-PCF Rulebook V3.0 as an important input for this CX-PCF Rulebook V4:

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