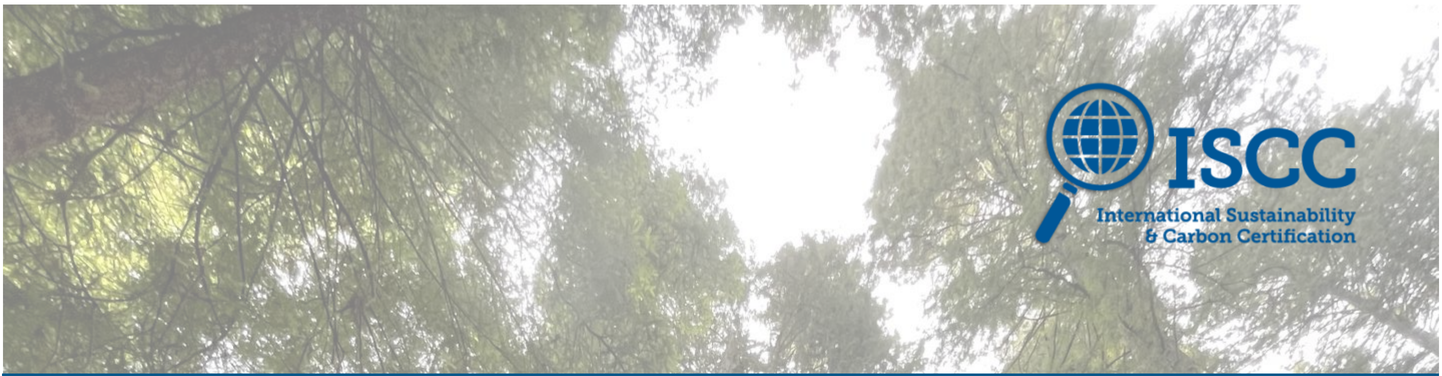

ISCC Carbon Footprint Certification

ISCC CFC

Version 1.3 - DRAFT

Document Title: ISCC Carbon Footprint Certification – System Document

Version 1.3 - DRAFT

Valid from: March 2025

Table of content

Summary of changes

ISCC is pleased to publish the update of the ISCC CFC System document (version 1.3). Part I of this document focuses on the methodological basis. ISCC CFC welcomes innovative technological solutions for reducing GHG emissions, such as e.g. carbon capture usage and storage (CCU, CCS), closed-loop systems, and optimized production conditions – published in Part II.

In detail, the following new aspects can be found in comparison to the previous version 1.2:

Part I

- Comparison ISCC CFC with ISO 14040/44/67 and TfS, and emission factors acceptance
- Guidance on system boundaries and life cycle impact assessment methodology
- Educational explanations on, for example, the GHG Protocol, life cycle assessment and Product Carbon Footprint (PCF) calculation structure in general, selection options for emission factors, handling design data, validity of PCFs
- Definition of the temporal validity of the certificate and PCF
- Details on required data quality and classification into data categories

Part II

- Update CCU Chapter:
    - CCU generalization (Methanol now is used as an example);
    - CCU approach to cover 100:0 benefit allocation;
    - expiration of credits over time
- Update CCS Chapter:
    - CCS specific amended credit allocation guidelines;
    - expiration of credits over time;
    - streamlined CCS documents and document flow

Abbreviations

AP	Acidification Potential
CB	Certification Body
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Utilization
CF	Carbon Footprint
CFC	Carbon Footprint Certification
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
EAF	Electric Arc Furnace
EoL	End-of-Life
EF	Emission Factor
EP	Eutrophication Potential
FU	Functional Unit
GHG	Greenhouse Gas
GWP	Global Warming Potential
H_2	Hydrogen
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ISCC	International Sustainability and Carbon Certification
kg	Kilograms
KPI	Key Performance Indicator
kWh	Kilowatt-hour
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
LULUCF	Land-Use, Land-Use Change and Forestry
MeOH	Methanol (in text)
MJ	Megajoule
NDC	Nationally Determined Contribution
MTBE	Methyl Tertiary-Butyl Ether
MWh	Megawatt Hour
NGO	Non-Governmental Organization
N_2O	Nitrous Oxide
ODP	Ozone Depletion Potential
PACT	Partnership for Carbon Transparency
PCF	Product Carbon Footprint
PCR	Product Category Rules
PEFCR	Product Environmental Footprint Category Rules
PO_4	Phosphate
PoO	Point of Origin
PPA	Power Purchase Agreement
PU	Processing Unit

SBTi	Science Based Targets initiative
SiO_2	Silicon Dioxide
SO_2	Sulfur Dioxide
t	tons
TfS	Together for Sustainability
UNFCCC	United Nations Framework Convention on Climate Change

List of figures

List of tables

List of formulas

Part I: ISCC CFC – Basics

1 Introduction

Paris Agreement and long-term strategies

The Paris Agreement invites its signatory states to develop a long-term strategy for a decarbonization of their societies by 2050. Many countries have already published and implemented such strategies aiming to stepwise minimize greenhouse gas (GHG) emissions and to achieve net zero emissions by 2050. This may be achieved by combining different measures such as reduction of fossil resource consumption, increase use of alternative and carbon-neutral feedstocks, permanent carbon storage, carbon utilization or carbon offsetting measures.

Companies are implementing long-term decarbonization strategies

Based on the Paris Agreement, many companies have started to implement long-term strategies and measures to decarbonize their business, supply chains, processes, and products as soon as possible, and at the same time to ensure long-term economic success. Part of this process is the determination and calculation of the relevant GHG emissions. Frameworks such as the Science Based Targets initiative (SBTi[1]) define and promote best practice in target setting and are supporting companies on this. Thus, the reporting of carbon footprints (CF) for individual production steps, products, value chains and entire companies has become increasingly important in recent years. The reporting of such data for companies is requested by many stakeholders, e.g. regulators, financial institutions, customers, and Non-Governmental Organizations (NGOs), to receive measurable and comparable information on relevant emissions. CFs for products is a key indicator for environmentally friendly products and an important indicator for the comparability of products for many customers. In addition, brand owners are asking their suppliers for detailed information on carbon emissions for their products, aiming to minimize the overall carbon emission of final products and their supply chain.

ISCC (International Sustainability and Carbon Certification) is a certification system that inter alia offers solutions for the implementation of decarbonization measures along complex supply chains. This document describes the overall guidelines for the "ISCC Carbon Footprint Certification (CFC)" which can be used by system users to determine GHG emissions for different processes, feedstocks, and products. Part I of this document focuses on the methodological basis.

ISCC CFC welcomes innovative technological solutions for reducing GHG emissions, such as carbon capture and storage (CCS), the use of renewable energies, closed-loop systems, and optimized production conditions. These and the corresponding emissions calculation are described in further explicit subchapters, explaining how the relevant emissions can be determined, and the certified products can be presented in a credible manner (see *PART II*).

[1] SBTi: *https://sciencebasedtargets.org*

ISCC EU and ISCC PLUS focus on the certification of sustainable and circular feedstocks and products along complex supply chain ensuring the chain of custody, traceability and supporting claims on the sustainability characteristics of final products, whereas ISCC CFC is verifying GHG emissions for feedstocks, processes and products. Thus, ISCC CFC might be used in future in combination with other ISCC certification schemes (as e.g., PLUS), but for today independent of these certification approaches. This might include supply chains with conventional feedstock (e.g. fossil-based) for which GHG emission reduction measures can be claimed. ISCC CFC will be further developed by ISCC and its stakeholders. It is foreseen that the module will in future integrate additional processes and methodologies to determine GHG emission reductions supporting the decarbonization of industries, except those approaches already being developed and published (see *PART II*).

ISCC CFC can be combined or stay as stand-alone certificate

For the certification of processes or products with reduced product carbon footprints (PCFs) a comparable and reproducible calculation of GHG emissions or PCFs is important. Wherever possible, ISCC aims to harmonize ISCC CFC with established norms and standards (e.g., ISO 14040/ 44 and especially ISO 14067, Together for Sustainability (TfS) PCF guideline, GHG protocol). However, since these norms do not always exhibit fully transparent, reproducible and unique guidelines for individual processes and leave room for interpretation, ISCC introduces additional unique guidelines for the developed certification and CF calculation approaches to improve and ensure comparability and reproducibility of the PCF results. The following *Table 1* quickly shows how ISCC CFC is guided by ISO 14040/ 44/ 67, and the relevant further development ISCC CFC is bringing:

ISCC CFC guided by ISO 14040/ 44/ 67

Transparent, reproducible & credible – following ISO, TfS & GHG protocol

Table 1: Comparison ISO 14040/ 44/ 67 & ISCC CFC

	ISO 14040/ 44/ 67	TfS	ISCC CFC
PCF calculation	✓	✓	✓
4 phases	✓	✓	✓
External, third-party revision	✓	(✓)	✓
Pre-defined system boundaries	✗	✗	✓
Database recommendation	✗	✗	✓
Impact assessment methodology recommendation	✗	✗	✓
System documents incl. individual project/ product description & mitigation technologies	✗	✓	✓
Audit procedures	✗	✗	✓
Audit/ revision report	✓	(✓)	✓
Auditor trainings	✗	✗	✓
Certificate update required (if e.g. recipe, production, EFs etc. change – resulting in different PCF; and for masses)	✗	✗	✓
Third party certified PCF	(✓)	(✓)	✓

1.1 Reason and goal for ISCC CFC

ISCC CFC refers to the impact category “Global Warming Potential” (GWP) or “Climate Change” – explicitly those that influence Climate Change (in kg of CO_2 equivalents (CO_2e)) – caused by a product and its production. Even if environmental impacts are calculated under ISCC CFC, the PCF, which is the quantitative indication of ISCC CFC, does not provide an absolute or precise prediction of additional environmental impacts of the product under consideration. An exact prediction is not possible due to the relative approach, uncertainties regarding the data basis and uncertainties in the data selection and potential software solutions used.

The aim of ISCC CFC is to maximize transparency, reproducibility, and credibility. The PCFs determined under ISCC CFC shall be identically assessed, transparent and fully comparable. This explains why ISCC CFC and its PCF support pre-defined reference flows and functional units (FUs), further referring to one final impact assessment methodology (IPCC, described in detail below) and allows the use of a specific, comparability-increasing, database (as e.g. ecoinvent, GaBi/ LCA for Experts/ Sphera, described in detail below) - in addition to the preferred use of primary data (described in detail below).

The strictly defined requirements regarding reference flows, databases, and impact assessment methodologies should lead to less variability in results. The ISCC carbon footprint certificates of all CFC certified entities are published on the ISCC webpage comparable to ISCC EU and PLUS certificates. ISCC CFC certification requires a verification process, called as ISCC CFC audit.

1.2 The difference between PCF and scope 1- 3 emissions

PCF ≠ scope 1, 2, 3 emissions

The PCF and the company-related scope 1, 2 and 3 emissions are two different approaches to recording and evaluating GHG emissions. Both play an important role in climate accounting, but they differ in their focus, methodology, and the framework they consider. The PCF measures the total GHG emissions generated during the entire or a partial life cycle of a product. This includes all emissions from raw material extraction (feedstock), production, and transportation to the use and disposal of the product. The PCF helps to quantify the climate impact of individual products, reduce it, and make products more climate friendly. It is also useful for communicating with customers, who are increasingly interested in the environmental compatibility of products. The definition of scope 1, 2, and 3 emissions was developed by the GHG Protocol to record a company's GHG emissions[2]. They cover direct and indirect emissions and provide a comprehensive overview of a company's climate impact.

Scope 1 represents direct emissions. These include all direct GHG emissions that originate from sources that the company itself owns or controls. Examples include emissions from the burning of fossil fuels in company vehicles or production facilities. These are therefore internal emissions over which the company has direct control.

Scope 2 is designated as indirect energy-related emissions. These are indirect emissions caused by the consumption of purchased energy, such as electricity, steam, heating or cooling. Although these emissions are not generated directly by the company, they are caused by the company's energy consumption. In short, these are energy-related emissions caused by the purchase and consumption of energy.

Scope 3 are further indirect emissions. These include all other indirect emissions that occur along the company's supply chain but are not included in scope 2. These include emissions from upstream activities (e.g. raw material production, logistics) and downstream activities (e.g. use and disposal of products by customers). Scope 3 therefore covers the entire

[2] The Greenhouse Gas Protocol. ISBN: 1-56973-568-9. Link: *https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf*

supply chain, including suppliers, customers, and other indirect sources of emissions.

The most important difference in connection with ISCC CFC is that the PCF considers the life cycle of a product from raw material extraction to theoretical disposal. In the case of ISCC CFC, the current focus is up to the factory gate – named cradle-to-gate. In future, the system boundaries will be expanded to cradle-to-grave, including the End-of-Life (EoL) and with that circularity aspects. Scope 1, 2 and 3, on the other hand, consider emissions in the context of a company's operations and its supply chain[3].

[3] The Greenhouse Gas Protocol. ISBN: 1-56973-568-9. Link: *https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf*

2 Basics and scope of application

ISCC CFC is based on the ISO standards ISO 14040, ISO 14044, and explicitly ISO 14067. Further, TfS, and the GHG Protocol are considered in the methodological development.

The aim of ISCC CFC is to increase transparency, reproducibility and credibility in PCF assessments and accounting. ISCC CFC focus is to limit the variability and selection options of the known and named standards, guidelines, and directives as e.g. ISO 14040/ 44/ 67, TfS and the GHG protocol. To reach the named goal, no new CF methodology is developed.

The application of ISCC CFC, based on the afore mentioned approaches, serves to

- Provide transparent, clearly reproducible, and credible CFs
- Enhance the integrity of the quantification of GHG emissions
- Support emission management and strategic support for environmental issues
- Enable companies to account and communicate on verified PCFs and emission savings
- Limit emissions and support reduced-emission innovations
- Optimize processes, production, and recycling

ISCC CFC can support the communication and reporting of CO_2 emissions, serve as a transparent and reproducible source and basis in GHG markets, and support risk management.

Evaluation

PCFs of feedstocks (raw materials), intermediates and products can be evaluated under ISCC CFC.

In general, this includes any physical product that is not classified as a service. However, services or services that trade the above-mentioned products and goods can obtain an ISCC CFC trader certificate, whereby the PCF of the product or goods does not change within the scope of the trader. Emissions resulting from transport or storage are borne by the next processing or purchasing entity as the end consumer (see *6.1 Trader*)

At present, certificates can only be issued under ISCC CFC for products or services whose technologies are already described in Part II. This can cover any products or services, but must, for example, apply one of the mitigation measures described.

3 ISCC CFC certification concept and documents

This chapter introduces the certification concept of ISCC CFC. It hence describes which entities could get certified, the basic features of an ISCC CFC certification and the required documentation. In addition, the chapter introduces various document templates and documentation ISCC provides to simplify the process of PCF calculation and certification for both the system user and the auditor.

3.1 System basics: The ISCC CFC certification concept

With the help of *Figure 1*, we will guide you through the ISCC CFC system basics and the required documentation of an ISCC CFC certification.

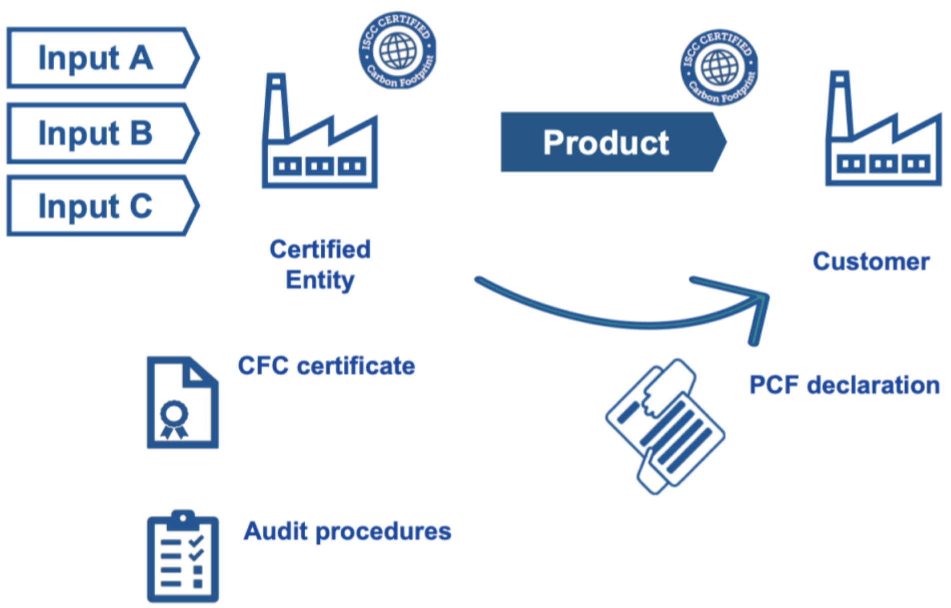

Figure 1: Certification under ISCC CFC and relevant documents

In general, there are two options for CFC certification:

- Inputs/Feedstocks A/ B/ C of the to-be certified site are not CFC certified (see example in figure 1). In this case, one of the technological (mitigation) chapters in Part II must be applied in order to obtain an ISCC CFC certificate at all. This means that the certified entity must apply a mitigation measure: for example, CCS, CCU or renewable energy.
- If inputs / feedstocks A, B and/ or C are already CFC-certified, the so-called downstream certification process for processing units or traders applies (see *6 Downstream entities*).

As described above, the inputs/ feedstocks A/ B/ C (left side of *Figure 1*.) can, but do not have to be certified under ISCC CFC. We provide detailed information on emission factors (EFs) and PCFs in *4.2 Data as the basis – LCI*. This approach differs from that of ISCC PLUS, where the whole supply chain needs to be certified to trace non-conventional feedstocks through supply chains.

All certificates and their associated documents refer to a site but focus on one/several specific product(s) that is produced at this site.

The product to be certified within the scope of ISCC CFC of a site is therefore audited. In order to carry out the audit process, we provide so-called **audit procedures**, which are explicitly tailored to the corresponding technology/ methodology. The audit procedures can currently be requested by the system user or auditor on request and are therefore not publicly available or accessible.

If the audit is successful, a **certificate** is issued. The certificate contains information about the product and the system boundaries but does not necessarily publicly disclose the value of the certified PCF but could do so if wished for. The certificate is uploaded to the ISCC Hub and can be viewed publicly on the ISCC website. To ensure that a customer of ISCC CFC certified materials receives all relevant information a **PCF declaration** is provided by the CFC certified entity to its customers containing all relevant information about the certified and delivered product including the actual PCF value. It is mandatory to pass this PCF declaration with the delivery of an ISCC CFC certified material to the recipient of the material (together with the delivery note, comparable to the ISCC PLUS Sustainability Declaration). The template of the PCF declaration document can be provided by ISCC on request and is not yet publicly available. The certified PCF on the PCF declaration is one of the relevant distinctions between ISCC CFC and, for example, ISO or TfS.

Validity periods for ISCC CFC certificate and PCF calculation: Annual mass balance verification and GHG revision every 3 years

The certificate is valid for one year (validity period of the certificate). The CF calculation (PCF in kg CO_2e) is reviewed every three years (validity period of the PCF calculation). This means after an initial CFC certification the PCF calculation needs to be reviewed at the third re-certification audit. However, if there are changes in e.g., the production process, in the recipe (i.e., PCF of used raw materials), shutdowns, plant turnarounds, a change in supplier (data), a change in software and/or database solution to calculate the PCF, an adjusted calculation must be reviewed at the regular yearly recertification audit after the changes had happened within the three-year validity period of the PCF calculation. If the PCF value should be updated during its three-year validity period due to e.g. the usage of another more appropriate EF for input materials, this can be done as well at a regular yearly recertification audit with the appropriate verification. If the PCF calculation is updated within the three-year validity period, this marks the start of a new three-year validity period. The mass balance of the certified products is verified yearly at the recertification audits. This includes the comparison of sold production volumes with required inputs like CO_2, renewable energy or CFC certified input materials.

The calculated PCF is always calculated retrospectively and therefore refers to a period before the audit date. This means that the calculated PCF applies from the audit date and is valid for the upcoming one to three certification periods (each one year). The material produced in a certification period is connected with the PCF valid in this certification period. This means that if an update of the PCF was done at a recertification audit and if certified material from the certification period before this recertification audit with PCF update is still available in the following certification period, the PCF for this material remains unchanged.

3.2 ISCC CFC documents and required documentation

First of all, this document, the so-called **system document**, describes all basics of ISCC CFC, detailed methodological/ technical approaches and information and requirements regarding the timeliness of data, for example. This system document is publicly available and can be used at any time and has no access restrictions.

3.2.1 Audit procedures

GHG/ LCA expert knowledge required for revision/ audit

The aim of the audit is to have external third parties (certification body (CB)) check the PCF calculation for its accuracy and plausibility, as well as transparency and reproducibility. Furthermore, the masses (produced and sold; incoming and outgoing) of ISCC CFC certified material are checked.

There is a specific audit procedure for the ISCC CFC audit, which allows the auditor to query generic information as well as subject-specific topics. All CFC certified system users are checked with regard to their inputs (feedstock and intermediate) and their outputs (products and waste & residues, and emissions). In cases where the CF changes (for all production units), the life cycle inventory (LCI), selected processes, and EFs are also verified during the audit. Specific aspects such as adaptation methods like carbon capture or the use of renewable energies, as well as products from e.g. the agricultural sector, are treated with separate additional questions. All so called system users, processing units (PU) or traders, producing or dealing ISCC CFC certified material need to get certified.

The information required and named in the following chapter (see 4 Methodological approach) have to be entered into the audit procedure by the CB. The aspects and questions relevant for ISCC CFC are queried via this audit procedure and no further written version is required.

3.2.2 ISCC CFC certificate

The certificate itself is an official document that is always published but does not have to include the PCF. After completed certification the ISCC CFC certificate is published in the ISCC certificate database on the ISCC webpage.

The ISCC CFC certificate contains information about the defined system boundaries (cradle-to-gate), about the certified product and the defined FU/ reference flow, which is related to the PCF. The certificate also contains annual information on the data sets used and whether the data is mainly primary or secondary data.

The certificate is issued after a successful audit/ verification of the PCF calculation by the CB. The issued certificate is uploaded via the ISCC Hub and checked by ISCC before final publication. With the official upload, the certificate becomes valid and the PCF or purely the information about the material certified with ISCC CFC may be communicated by the system user.

3.2.3 PCF declaration

After a successful audit and the official upload of the certificate - with or without an indication on the certificate for the PCF – it is mandatory to pass on the PCF value to customers of the system user/ certificate holder. This information is passed on as part of a so-called PCF declaration.
Among other information the named PCF declaration needs to provide the following information (only partially included in certification certificate):

- Information on date of issuance and the CB name who issued,
- Information on supplier and recipient, unique number of PCF declaration,
- Type of product,
- FU and/ or reference flow (quantified material),
- PCF in kg CO_2e (voluntary but very welcomed by ISCC CFC),
- Quantity of product with given PCF delivered,
- System boundaries.

3.2.4 CO_2 declarations

For the audit, it may be necessary for the system user to complete and provide so-called **CO_2 declarations** – so far in use in CFC's CCU and CCS approach (see chapter below in *PART II*) with regard to the use and calculation of credits (information and assurance from both the CO_2 capturer and the CO_2 user about who includes which emissions or credits in their own calculation). These self-declarations can be requested in the same way as audit procedures and are not publicly accessible.

The CO2 declarations of ISCC CFC differ from the CO2 self-declarations of the other ISCC schemes, hence only CO2 declarations of CFC can be used under ISCC CFC.

4 Methodological approach

The approach of ISCC CFC follows the named established norms and guidelines:

- ISO 14040,
- ISO 14044,
- ISO 14067,
- TfS,
- GHG Protocol.

Deviations or stricter standardizations compared to the ISO standards, for example, are explained in the respective subchapters. These “restrictions” under ISCC CFC serve to limit the selection options in the calculation process and thus improve the comparability and reproducibility of the PCFs, without the need to define a completely new methodology of PCF calculation.

4.1 Goal and scope

All aspects – being relevant for ISCC CFC certification – are described in this document. In addition, the ISCC CFC audit procedures shall be used by auditors to conduct ISCC CFC audits.

4.1.1 Aim and purpose

ISCC CFC does not require the aim and purpose to be stated, but it can be useful for the CF implementer to clearly define the aim and the addressees of the study. Why is the study being carried out, what will the results be used for, and to whom and in what form will they be communicated? Should the PCF be shown in the final appendix of the certificate or is it not intended for public communication?

4.1.2 Scope

In contrast to aim and purpose, the scope for auditing ISCC CFC must be specified and is also checked in the audit procedures.

The following aspects for the auditing of ISCC CFC must be specified under scope:

- Product system to be audited,
- FU or reference flow - the quantity to which the CF relates,
- System boundary,
- Allocation procedure,
- Possible cut-off criteria,
- Selected impact assessment,
- Data requirements (sources of secondary data),

- Temporal reference period,
- Spatial situation (country/ location of production),
- Software solution used to calculate the CF.

The calculation and analysis of the CF is an iterative method. During data collection and accounting, various aspects of the scope of the study may require modification to achieve the original objective of the study. Changes within the assessment are possible at any time. However, the balance sheet/ CF to be certified must be finalized and made available to the auditors without any further changes – otherwise a new audit needs to be done.

4.1.3 System boundary

In general, CFs or PCFs are created by defining product systems as models that describe the most important elements of physical systems. The system boundary defines the process modules to be included in the system. Ideally, the product system should be modeled in such a way that the inputs and outputs at its boundaries are "untreated" flows. In this way, an accurate CF based on primary data can be mapped with a high degree of accuracy across an entire supply chain.

When setting the system boundary, several life cycle stages, process modules and flows should be taken into account (see *Figure 2*), e.g. the following:

- Extraction of raw materials (primary),
- Use of secondary materials (including potential burdens of reuse, recycling, and energy recovery),
- Inputs and outputs of the main manufacturing and processing steps,
- Distribution/ transport,
- Production and use of energy sources, electricity, heating or cooling,
- Utilities and auxiliaries,
- Disposal of waste generated in the process and of products,
- Production of consumables,
- Production, maintenance, and decommissioning of production facilities,
- Additional processes, such as lighting and heating.

ISCC CFC focuses on the cradle-to-gate system boundaries. Other possible system boundaries are not excluded. The integration of EoL modeling and credit allocation is considered, for example in the examples of adaptation and carbon capturing.

4.1.4 Functional unit and reference flow

A functional unit (FU) defines the quantification of the specified functions of the product. The main purpose of a FU is to create a reference to which the input and output data are normalized. Therefore, the FU must be clearly defined and measurable.

Once the FU has been selected, the reference flow must be defined. Comparisons between systems must be made based on the same function(s) quantified with the same FU(s) in the form of their reference flows.

Reference flows are the measured outputs of processes that are required to fulfill the function to which the input and output flows are related (see *Figure 3*). It is important to define the reference flow in each product system to fulfill the intended function, i.e. the quantity of products necessary to fulfill the function.

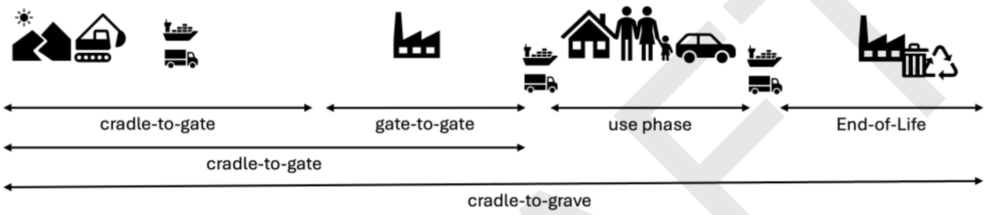

Figure 2: System boundaries – ISCC CFC focus: cradle-to-gate

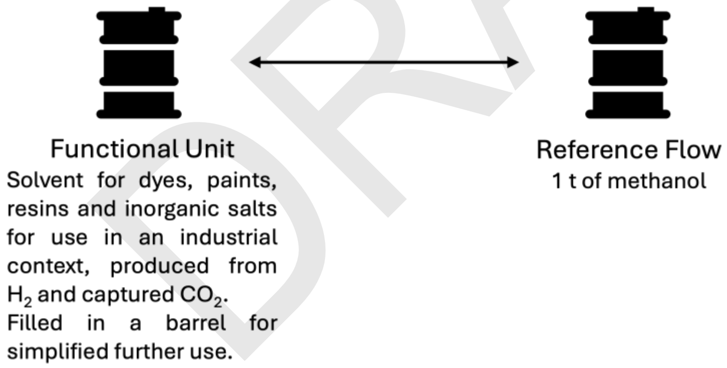

Figure 3: Simplified example FU vs. reference flow

4.1.5 Cut-off criteria

Cut-off criteria are the definition of material quantities or energy flows associated with process modules or product systems that are to be excluded from a study. In the best case, there are no cut-off criteria, and all material quantities and energy flows are taken into account in the analysis.

The following cut-off criteria apply to ISCC CFC:

Material quantities (mass)

Using mass as a criterion requires the inclusion in the study of all inputs that contribute more than 1% to the mass input of the product system being modeled must be included.

Important: If the initial identification of inputs is based solely on the mass contribution, this can lead to important inputs being omitted from the study. Accordingly, the energy cut-off criteria should also be considered in this process.

Energy flows

Using energy as a criterion, all inputs that contribute more than 1% of the energy input of the product system must be included in the study.

For ISCC CFC, this requirement also applies to infrastructures for manufacturing products. For example the construction of facilities and equipment used for production, do not necessarily have to be included in the PCF – if assumptions and explanations are given. Only the possible production itself and the energy required for it, must be included.

4.1.6 Allocation

Operations rarely produce a single output or rely on the linearity of raw material inputs and outputs. Most operations produce more than one product and use intermediate products or waste and residues as raw materials. It should be noted that allocation procedures are necessary when dealing with systems that produce or utilize multiple products. Allocation is the assignment of the input or output flows/ emissions and credits of a process/ product system to the product (system). On the other hand, the term attribution is often used, when assigning an input with specific sustainability properties like e.g. the origination from a non-conventional feedstock to products of a process in a mass balance system (e.g. under ISCC PLUS). Under ISCC CFC, we differentiate between products, which are valuable and to which emissions are allocated, and waste and residues that are considered to have zero emissions. Products may cover main products, co-products and by-products as a sub-category of co-products.

Side information:

Main Products: Main products are defined as products that the process is operated for and optimized to produce.[4]

By-product: Product output from a unit process that is an unavoidable but not desired. A product, resulting from a production process, the primary aim of

[4] Together for Sustainability, v 2.1, 2024

which is not the production of that product may be regarded as not being waste but as being a by-product if the following conditions are met:

- *Further use of the substance or object is certain;*
- *The substance or object can be used directly without any further processing other than normal industrial practice;*
- *The substance or object is produced as an integral part of a production process; and*
- *Further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.*[5]

Co-Product: Any of two or more product outputs coming from the same unit process or product system[6]*. Co-products may be main products or by-products.*

Waste and residues: Substances or objects which the holder intends or is required to dispose of.

The sum of the inputs and outputs of a process module assigned by allocation must be equal to the inputs and outputs of the process module before allocation. Processes that are used together with other product systems must be labelled and handled according to the following step by step procedure[7]:

Step 1 – Avoiding allocation (preferred solution)

ISCC CFC preference: avoid allocation by subdivision

Formally, the first step is not part of allocation, but should be considered in the allocation process - always avoid allocation if possible. The preferred solution by ISCC is the subdivision of the process modules: The shared production process is divided into sub-processes so that products are produced separately and input and output data relating to these sub-processes are collected. The process only needs to be subdivided to the point where the products and their function are isolated.

Step 2 – Use and apply allocation (avoid if possible)

If allocation cannot be avoided by the named subdivision of systems, emissions are allocated based on economic value or the underlying physical relationships between the products (see *Figure 4*). A physical factor should accurately reflect the underlying physical relationship between the products and emissions. For example, if the weight of the output determines the quantity of emissions, allocation should not be based on the energy content, but on the mass of the output.

[5] DIRECTIVE 2008/98/EC, Waste framework directive
[6] ISO 14040
[7] following ISO 14040/ 44/ 67 and TfS

Prerequisites:

- A physical relationship can be established.
- Changes in the physical output of the products correlates with changes in emissions of the shared process.

Examples of physical factors are mass, volume, energy content of heat and electricity, number of units produced, protein content of food-BPs, and chemical composition.

ISCC CFC decision tree for allocation: no allocation > economic allocation> physical allocation

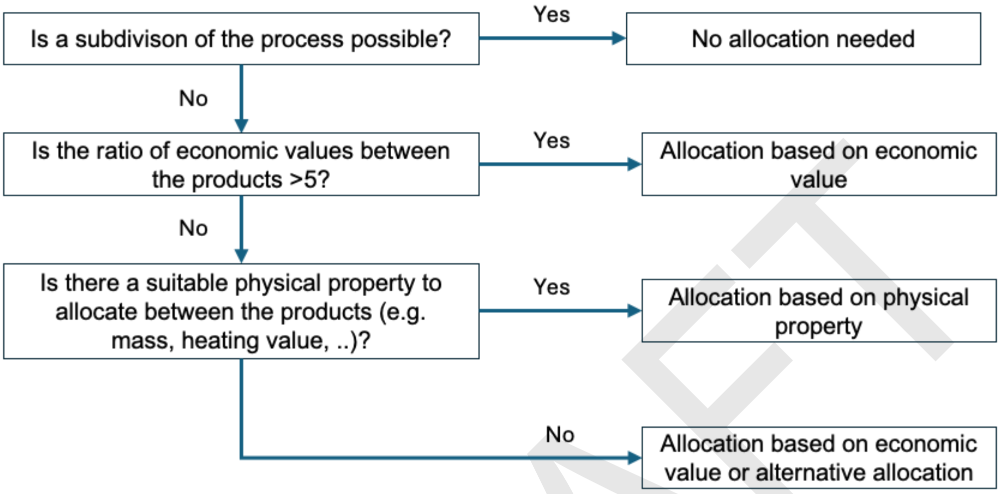

Figure 4: ISCC CFC Allocation decision tree

The same allocation methods should be applied to similar inputs and outputs to ensure consistency. If there is no suitable physical property for allocation, economic allocation or alternative allocations need to be considered (see *Figure 4*).

Besides the named guidance provided by ISCC, the rules in already published so called Product Category Rules (PCRs) should be used, as named by TfS (TfS, ISO 14000 series, Partnership for Carbon Transparency (PACT), GHG, Product Environmental Footprint Category Rules (PEFCR)). TfS, as example, accepted PCRs especially for the chemical sector as e.g. for steam cracker[8].

4.1.7 Benchmarking

Benchmarking is an instrument for analyzing competition. It is the continuous comparison of products, but also of processes and methods. Benchmarking is used to identify differences, determine the reasons for these differences, and establish how products (or processes and methods) can be optimized in terms of their emissions, for example.

As each key performance indicator (KPI) indicates a performance, a target is required to put the KPI into context and thus show whether the target value has been or can be achieved. Benchmarking to support target setting and to

[8] PlasticsEurope recommendation on Steam Cracker allocation, 2017

define KPIs also offers the potential for continuous improvement through efforts to achieve results that meet or exceed the benchmark or target. Benchmarking always involves a comparison with external values (learning from the best) and therefore does not include internal comparisons such as with a company target. Benchmarking values under ISCC CFC can be partially found in the individual technological mitigation chapters (part II), such as for low-carbon methanol (MeOH) or silicon metal. In this context, the benchmarks are given as an absolute value in kg CO_2e and an expected reduction in percentage defines the target for each new ISCC CFC project/ certificate (see e.g., *7 Carbon Capture and Storage (CCS)*, *8 Carbon Capture and Utilization (CCU)* or *9 Silicon metal produced with renewable energies*. These benchmarks were defined in the course of individual pilot projects during the development of ISCC CFC. However, ISCC is not in the position to define benchmarks for products certified under ISCC CFC. Hence, in general ISCC CFC is not making use of benchmarks or reference values and only focuses on the individual absolute PCF – independent of other values.

4.2 Data as the basis – LCI

The LCI is the compilation and quantification of inputs and outputs of a given product over the course of its life cycle. The process of creating a LCI is iterative. As data is collected and the system is studied in more detail, new data requirements or limitations may be identified that require a change in data collection procedures so that the objectives of the study can still be met.

Consequently, within ISCC CFC, all feedstocks (including energy) (in LCA (Life Cycle Assessment) often named as input) are considered and quantified to produce the desired product (output). Energy inputs and outputs must be treated like any other input or output. The energy inputs and outputs must include the energy required for the provision of energy carriers, the energy content of non-energy feedstocks and the process energy used in the system to be modeled. Transportation routes, processing steps or similar steps that generate emissions through actions are also included.

To include all aspects in the LCI or data collection, it can be advantageous to use a visual representation. This visual representation is also known as a flow chart and is intended to improve process understanding.

The process modules and their interrelationships are shown in this system flow diagram. Each process module should first be described in order to determine where the process module begins and ends with regard to the supply of feedstocks or intermediate products.

The PCF calculation is based on actual data gathered from the ISCC system user and data sourced from databases and literature.

Data gathering is relevant for the process inputs defined in the PCF calculation equation including e.g. energy consumption, other process inputs and output data like process emissions, wastes, products and BPs. Relevant parameters, which cannot be measured directly, shall be calculated based on the input and output flows of the process.

Actual data measured and gathered at the system user's site must be documented and provided to the auditor for verification. This can include production controlling sheets, production reports, production information systems, delivery notes, weighbridge protocols, contracts, invoices, and others. The calculation period should cover a full twelve-month period. It must be as up to date as possible, not older than three years. As an alternative, it must cover the previous calendar or financial year. In cases of exceptional maintenance measures and unstable production conditions a shorter period (for inputs and respective outputs) may be considered if it better reflects the relevant timeframe. The respective period for data gathering and thus for the calculation of GHG emissions must be transparently displayed in the calculation.

4.2.1 Data categories

The data selected for the PCF depends on the objective and the scope of the study, as well as on the defined FU and its reference flows (goal and scope, and system boundaries). Furthermore, a distinction is made in the nature of the data as to whether it is primary data or secondary data:

- Primary data is collected and measured at the production sites which are assigned to the process modules within the system boundary.
- Secondary data can be taken and calculated from other peer-reviewed/ credible sources (e.g. publications, databases).

ISCC CFC is demanding primary data for PCF calculation. In case primary data is not available, secondary data (incl. design data) can be processed. A PCF assessment can be done even before the production itself started, being based on design data. Design data is allowed to be used at the initial and the first recertification audit. However, six months after the initial audit and at the recertification audit a revision of the design data and a comparison to the actual production data needs to be done. An update of the PCF is required using the primary production data if it significantly varies (+/ - 10%) from the design data value. The comparison of the design data with actual production data can occur with actual data from a limited period, e.g. even on a one-month basis or up to a few months depending on the timeframe of operation. The used actual data (one or more months period) needs to be seen as representative by the system user and as plausible by the auditor/CB.

On-site data gathering

The following data for the calculation of PCFs for products must be gathered on-site. They will form the basis for the calculation of GHG emissions. All input values must be gathered for the same reference time period (identical start and end date). In the example below the period of 1 year is used.

- Amounts of carbon monoxide (CO), CO_2 and other feedstock inputs introduced into the process (e.g., per t of CCU product per year) as well as their specific source (e.g., syngas process)
- Source and amount of electricity used for the operations (e.g., MWh per year)
- Source and amount of process heat used for the operations (e.g., MWh per year)
- Type and amount of additional process inputs (e.g., t per year)
- Amount of products produced (incl. mitigation technologies) (e.g., t per year)
- Amount of BPs produced (e.g., t per year)
- Amount of process wastes (e.g., t per year). Waste streams might be clustered in case the EF for their treatment processes is the same.
- Amount and composition of flue gas and other direct process emissions, especially in relation to climate relevant emissions (e.g., CO_2, CH4, N_2O, etc. in t per year). If these emissions cannot be measured directly, they shall be calculated based on the process inputs and outputs.

Missing data and estimated data (including e.g. assumptions made, approximate data sets) must be documented. For all process modules and for each data source where missing data is identified, the treatment of missing data and data gaps must result in

- A "non-zero value", which is explained,
- A "zero value", if justified, or in
- A calculated value based on recorded values from process modules using similar technology.

If data has been taken from published sources (secondary data), the source must be referenced. As the data is taken from various sources - both site-specific as well as publicly available data sources, measures should be taken during data collection to ensure a consistent and coherent understanding of the product system to be modeled.

The following types of data for the calculation of GHG emissions can be gathered from reviewed databases and literature as well as from official statistics:

- EFs for the production and supply of the process chemicals,
- EFs for the supply of the feedstock to the syngas process,
- EFs for the production and supply of additional process inputs,
- EFs for electricity and other energy sources in kg CO_2e per unit of energy used,
- EFs for the treatment of wastes and residues.

If no primary data/measurement data are available, EFs can be sourced from and are accepted by the auditor from the sources in the following (no on-site visits required under other schemes/reviews):

- ISO 14040/44/67 critical reviews,
- TfS revision trust-level 3,
- TfS revision trust-level 2, with an additional auditor revision of the activity data used for that TfS calculation,
- LCI databases such as, e.g., ecoinvent, GaBi (Sphera), SimaPro, etc.; the used database needs to be named in the audit procedures,
- Publications from international, competent organizations such as Intergovernmental Panel on Climate Change (IPCC), International Energy Agency (IEA) or governments,
- Other reviewed sources of data, such as E3 database, GEMIS database incl. justification for that data source and the used EF,
- Peer-reviewed, scientific publications.

For all of the above points, the auditors must check whether the method meets the standards and covers the entire life cycle, for example whether the data is geographically representative and up-to-date. This review must be carried out on an exemplary basis. The auditor selects data sets that account for at least 5% of the total PCF individually and at least 50% of the total PCF in total.

EFs for energy

EFs for energy follow in principle the above-mentioned sequence.

The use of energy from renewable sources can contribute to the reduction of associated upstream emissions.

To avoid double counting of energy related emissions, appropriate EFs can be identified following ISO 14067.

All data used to calculate the PCF should be as up-to-date and geographically appropriate as possible. Measured data from the production must be used. In case this data is not available, alternative data sources must be used. Calculated data must not be older than three years. Only in cases where a secondary data was used and the data set was not updated by the third-party provider (e.g. database), older data sets can be used whereby proof of this must be provided.

Geographically appropriate data must be used. In cases this is not possible, a detailed justification and an alternative data set that is as appropriate as possible must also be used.

Data accuracy is crucial for ISCC CFC. The objective is to be able to specify the PCF as representatively, comprehensibly and in as much detail as possible. Further details on uncertainties can be found in the following section and in *Table 2* in particular.

4.2.2 Data quality

The quality of the input data used to calculate a PCF is a key determining factor, greatly influencing the overall uncertainty associated with the PCF result. It is therefore important to understand how the quality of the data used for the calculations has been evaluated by the authors of a PCF calculation and verified by the auditors as part of the auditing process under ISCC CFC. Thus, system users are required to evaluate the quality of their input data, according to a standardized approach, explained in the following table, which follows a state-of-the-art approach in LCA.

Data sources must be evaluated based on distinct attributes: "reliability", "completeness", "temporal correlation", "geographic correlation", and "further technological correlation". Furthermore, each attribute is categorized into five levels of quality, ranging from 1 to 5. Consequently, every individual input and output exchange documented in a data origin is assigned a set of five indicator ratings, known as a pedigree matrix.

A simplified example for the application of the data quality evaluation scheme is shown below the table (see *Table 3*).

Table 2: Indicators of data quality, modified from Weidema, 1998[9]

Score / Indicator	1	2	3	4	5
Reliability **of the data**	Verified data based on actual measurements	Verified data partly based on assumptions or non-verified data based on actual measurements	Non-verified data partly based on qualified estimates	Qualified estimate (e.g. by industrial expert)	Non-qualified estimate or unknown origin of data
Completeness **of data**	Representative data from all processes relevant for the product considered, over a period of 12 months.	Representative data from a smaller number of processes (>50%) relevant for the product considered, over a period of 12 months.	Representative data from only some processes (<50%) relevant for the product considered or >50% of processes but from shorter periods.	Representative data from only one process rel- evant for the product considered or some sites but from shorter periods.	Representativeness unknown or incomplete data from a small number of processes and from shorter periods
Temporal **correlation**	Less than 2 years of difference to the time period of the dataset.	Less than 3 years of difference to the time period of the dataset.	Less than 4 years of difference to the time period of the dataset.	Less than 5 years of difference to the time period of the dataset.	Age of data unknown or more than 5 years of difference to the time period of the dataset.
Geographical **correlation**	Data from area under study.	Average data from larger area in which the area under study is included.	Data from area with similar production conditions.	Data from area with slightly similar production conditions.	Data from unknown or distinctly different area.
Further **technological correlation**	Data from enterprises, processes and materials under study.	Data from processes and materials under study (i.e. identical technology) but from different enterprises.	Data from processes and materials under study but from different technology.	Data on related processes or materials.	Data on related processes on laboratory scale or from different technology.

Example: Application of data quality indicators

The following example shown in *Table 3* makes use of *Table 2* and can be seen as template for future projects and individual assessment.
Case description: 2.5 year ago, the engineering department estimated based on experience with the same process in a similar region that the demand of electric energy would be 0.89 kWh per kg of reference product produced.

Evaluating the data quality of this information, its data quality can be determined as (3,1,2,3,1), given an additional explanation for the indicator and scope selection. The explanation for the result is shown in the following *Table 3*.

[9] Weidema, B.P. Multi-user test of the data quality matrix for product life cycle inventory data. Int. J. LCA 3, 259–265 (1998). *https://doi.org/10.1007/BF02979832*

Table 3 Example for data accuracy/ uncertainty - using the indicators of data quality (*Table 2*)

Data quality indicator for the amount of electricity used	**Pedigree-Score** (according to *Table 2*)	**Explanation**
Reliability of the data	3	Data from engineering and from assumptions based on experiences with similar processes in other production units.
Completeness of data	1	Engineering data and assumptions for all process and sub-process units involved in the production of the product under study.
Temporal correlation	2	The data from engineering was developed 2.5 years ago.
Geographical correlation	3	Data from engineering and assumptions based on experiences with production units in an area with similar production conditions.
Further technological correlation	1	The data has been developed for this specific process.

4.3 Extrapolation of emissions – LCIA

In the life cycle impact assessment (LCIA) phase of the CF calculation under ISCC CFC, the aim is to assess the significance of potential environmental impacts with the help of the LCI results. In general, LCI data is linked to the specific impact category global warming (characterization) and the impact indicator GWP (classification) in kg CO_2e in this step. This linking is often carried out by software solutions but can also be done manually in Excel due to the simplification to one indicator.

In ISCC CFC practice, this means that the system user either commissions a PCF or carries it out himself, focusing on the global warming impact category; or this is done manually using Excel, for example, and the EFs for the GWP indicator are obtained from databases or secondary literature.

The selection, modeling, and assessment of the EFs and processes in the databases mentioned can introduce subjective elements into the impact assessment phase (see therefore the detailed technical description). Transparency is therefore crucial in impact assessment to ensure that the assumptions are clearly described and presented. This is also requested in the ISCC CFC audit procedure and requires detailed justifications.

4.3.1 Impact assessment methodology

Depending on the impact assessment method, characterization and classification take different courses - for example, the allocation of emissions to an impact category or the weighting of emissions in relation to CO_2 in the classification. To allow as little variability as possible in the results under ISCC CFC, ISCC CFC welcomes the restriction of possible impact assessment methodologies and thus again increases transparency and comparability - as with the requirements for data accuracy.

If possible, the IPCC methodology is preferred to be used under ISCC CFC.

4.3.2 Midpoint indicator - CF

As part of the classic LCA according to ISO 14040/ 44, there is a larger number of indicators, so-called midpoint indicators, which are calculated and analyzed in a comprehensive LCA. It is not uncommon for these midpoint indicators to conflict with each other. For the sake of completeness, we will briefly discuss the following midpoint indicators as examples of the complete LCA.

Eutrophication potential (EP)
Eutrophication describes the accumulation of nutrients such as nitrogen and phosphorus in water bodies, which leads to excessive algae growth and oxygen depletion. This over-fertilization can disturb the balance of ecosystems, harm fish and other aquatic life, and impair water quality. The EP is expressed differently depending on the LCIA method but is often expressed in kg phosphate equivalents (kg PO_4e).

Acidification potential (AP)
Acidification refers to the release of acidic substances, such as sulphur and nitrogen oxides, which convert to acids in the atmosphere and fall as acid rain. This can damage soils, water bodies, and vegetation, as well as lower the pH value in ecosystems, causing long-term damage to biodiversity. AP is measured in kgs of sulphur dioxide equivalents (kg SO_2e).

Ozone depletion potential (ODP)
This potential measures the ability of chemicals to deplete the ozone layer in the stratosphere. Substances such as chlorofluorocarbons are known to do this. The depletion of the ozone layer leads to increased levels of ultraviolet radiation on earth, which increases health risks such as skin cancer and negative effects on plants and animals. The ODP is measured in kg of R11 equivalents (kg CFC-11e).

However, within the framework of ISCC CFC - as the name suggests - we only focus on the CF and therefore only on one very specific impact category: Climate Change or GWP-100 (i.e. over a period of 100 years). The GWP, often also known as CF or CO_2 footprint, quantifies the GHG emissions of a product or activity that contribute to the greenhouse effect and thus to Climate Change. Increased GHG concentrations lead to global warming, which results in climatic changes, rising sea levels, and extreme weather events. The CF is expressed in kg CO_2e.

To calculate the CF, the concepts of **classification** and **characterization** are used as part of a LCA. In the classification phase, all relevant emissions and influences that occur during the life cycle of a product are identified and assigned to the corresponding environmental impacts (impact categories). For the CF, all emissions that contain climate-relevant gases such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are assigned to the "GWP" category. In the characterization phase, the identified emissions are assigned a specific weight based on their potential to contribute to global warming. This is done by applying so-called **characterization factors**. CO_2 has a characterization factor of 1, as it serves as a reference value. CH_4, however, has a higher characterization factor as it is about 25 times more effective than CO_2 in increasing global temperatures over a period of 100 years. N_2O has a factor of around 298, which means that one kg of CH_4 or N_2O corresponds to 25 or 298 kg of CO_2, respectively.

The CF calculation, which is determined and subsequently certified under ISCC CFC, is therefore always carried out as follows - analogous to ISO 14067: First, all emissions that occur in the various phases of the product life cycle (raw material extraction, production, transportation) are recorded. These emissions are then assigned to the environmental impact category "GWP" (classification), based on the type of GHG emitted. The individual GHG are converted into CO_2e by applying the characterization factors (characterization). Finally, all emissions converted into CO_2e are added together to determine the total CF of the product or activity. The afore mentioned allocation and conversion are often carried out with the help of software solutions and is described here primarily as basic background knowledge for interested parties.

4.4 Results and interpretation

The evaluation is the phase of the LCA or PCF in which the results are considered. The evaluation phase should provide results that are consistent with the defined objective and scope and that are used to derive conclusions, explain limitations and make recommendations. The evaluation should reflect the fact that the results of the impact assessment are based on a relative approach. The results of this evaluation can be presented in the form of conclusions and recommendations to decision makers, in accordance with the objective and scope of the study conducted.

A relevant aspect in the interpretation of the results, especially for decision-makers, is the focus analysis or hot-spot analysis. This is a statistical procedure that identifies the data that makes the greatest contribution to the indicator value - i.e. the GWP under ISCC CFC. This data can then be analyzed with higher priority to ensure that sound decisions are made. Furthermore, these so-called hot-spots can also be revised in a sensitivity analysis to provide the best possible decision support regarding a low-carbon product or even an entire production.

Under ISCC CFC, the PCF is output as an absolute figure in kg CO_2e per FU/ reference flow as part of the interpretation. The presentation on the final certificate is voluntary - except for the product silicon metal.

4.5 Sensitivity analysis

The sensitivity analysis in general is a method for investigating how sensitively the results of a model or calculation react to changes in the input parameters. It helps to identify the uncertainties and weaknesses of the model by showing which variables have the greatest influence on the result. In practice, the input parameters are systematically varied to see how strongly these changes influence the result. This allows important influencing factors to be identified and better understood. In the context of a LCA or just a PCF, sensitivity analysis is used to check how robust the results of an environmental assessment are. Since a LCA/PCF is based on many assumptions and estimates, sensitivity analysis helps to understand how changes in these assumptions could affect the final result.

5 Audit process and verification guidance

The following verification approach is required for all individual calculations:

- Every CB that reviews and verifies individual GHG emission calculations (e.g. PCF) needs to have at least one GHG/LCA expert auditor who is responsible for verifying the methodology and the input data prior to the audit. To become a GHG expert, the auditor needs to take part in the ISCC CFC training and write a test based on the respective training.

  Disclaimer: The training is currently under development and will be published in autumn 2025.

- The methodology used and the calculation itself must be done according to the ISCC CFC guidelines and presented in a reproducible and transparent way, which allows the auditor to verify the calculation.
- The ISCC CFC system user must select an independent CB/ auditor to audit the PCF under ISCC CFC in accordance with the audit procedures provided by ISCC.
- The ISCC system user must make the GHG emission calculation available to the CB (e.g. in Excel or via software solutions).
- The GHG/ LCA experts of the CB check information (e.g. methodology, actors (EFs), lower heating values, other standard values) prior to the on-site certification audit. If they have any questions and/ or require any corrections, the CB can contact the system user directly for clarification.
- During the certification audit, the auditor verifies all relevant information concerning the calculation of actual GHG values, with a specific focus on the plausibility of the input data (e.g. type of heat, amount of input materials, plant capacity, mass of products produced).
- If the CB requests any corrections in the PCF calculation, system users must provide an updated GHG calculation to the CB so that a final confirmation can take place. Corrective measures shall be implemented within 40 days.
- System users are only allowed to use the ISCC CFC certified PCF after the CB has explicitly confirmed that it is correct.
- If a system user wishes to update a calculation which has already been verified, the system user must contact the CB. It is the responsibility of the CB to decide if an on-site audit is necessary to verify compliance with ISCC requirements.

In any case, the CB needs to provide ISCC with updated certification documents (ISCC CFC certificate, audit procedures, GHG calculations).

The system user must provide records and evidence of the following data which will be verified during the audit:

- Evidence of all data for all relevant in- and outputs of the production process (e.g., production reports, sustainability information, invoices (e.g., energy)).
- Sources of EF (e.g., scientifically peer-reviewed literature, LCA databases such as ecoinvent) including the year of publication and their applicability (with respect to time and region). In the case of input materials, it is important to indicate the source of the PCF/ EF used (default value, ISO critical review, ISCC certified) (see *4.2 Data as the basis – LCI*). This is particularly relevant for long supply chains with several energy-intensive steps.
- Sources/ explanation as a basis for the allocation to (by-)products.

6 Downstream entities

Downstream entities handling CFC certified material need to be ISCC CFC certified, if they want to forward PCF information of the certified products under ISCC CFC. A downstream entity is every unit following a CFC certified entity, which is certified according to the above-described certification approaches for different decarbonization measures (e.g. CCS, CCU or low carbon silicon metal production). Depending on the purpose of the downstream unit, two different CFC certification scopes are applicable, which differ in certification and audit requirements: Traders and PUs processing CFC certified material (see *Figure 5*).

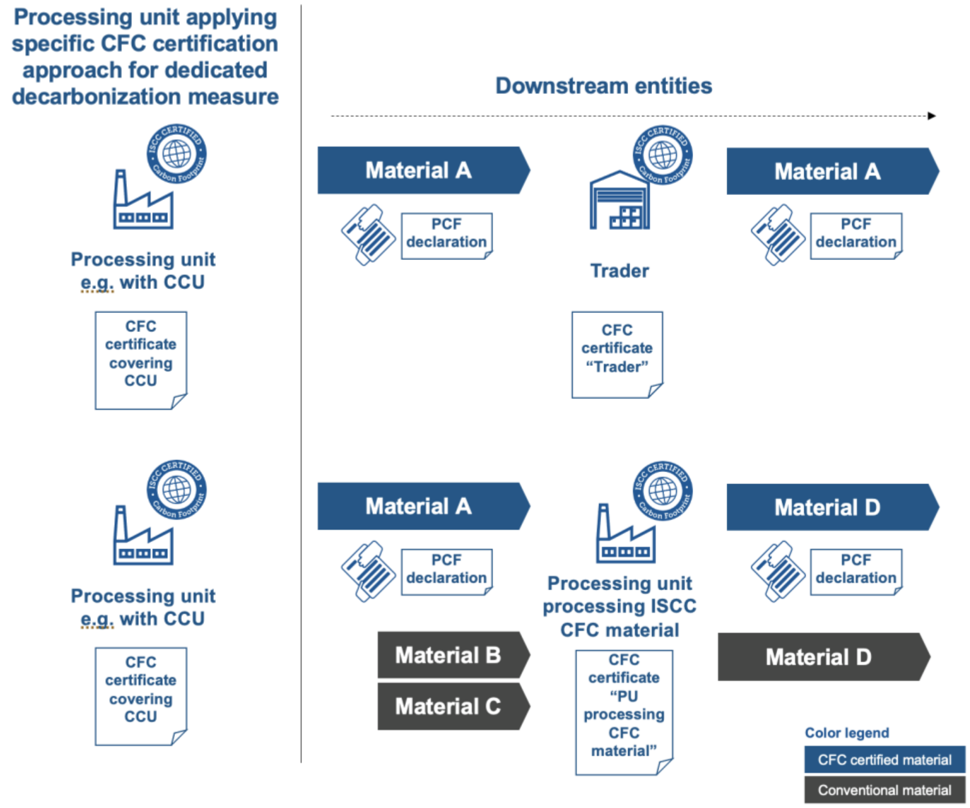

Figure 5: ISCC CFC certificate for downstream entities handling CFC certified material: Trader and PU processing CFC material

6.1 Trader

6.1.1 Certification requirements and handling of CFC certified material

Trading entities trading CFC certified material need to have an own CFC trader certificate. CFC traders need to implement a mass balance for ISCC CFC certified material, including the documentation for incoming and outgoing ISCC CFC certified material, e.g. "Low carbon CCU MeOH". Same mass balance principles apply as for ISCC PLUS certified traders. ISCC CFC certified traders receive and issue ISCC CFC PCF declarations with the respective amounts of certified CFC material. If an ISCC CFC certified trader also trades ISCC PLUS or EU certified material (via own EU/ PLUS certificate), they need to implement separate mass balances for CFC, EU and

PLUS certified material (also in case of the same chemical material, e.g. MeOH).

6.1.2 Emission calculation

Trading entities will not do an individual (product) CF calculation. They issue PCF declarations with the same PCF value as received from the previous PU, which is the "cradle-to-gate" PCF of the upstream PU, which produces the CFC material (see *Figure 6*). The following PU downstream the trading entity needs to consider all transport and storage emissions between upstream PU producing CFC material and the gate of the downstream PU.

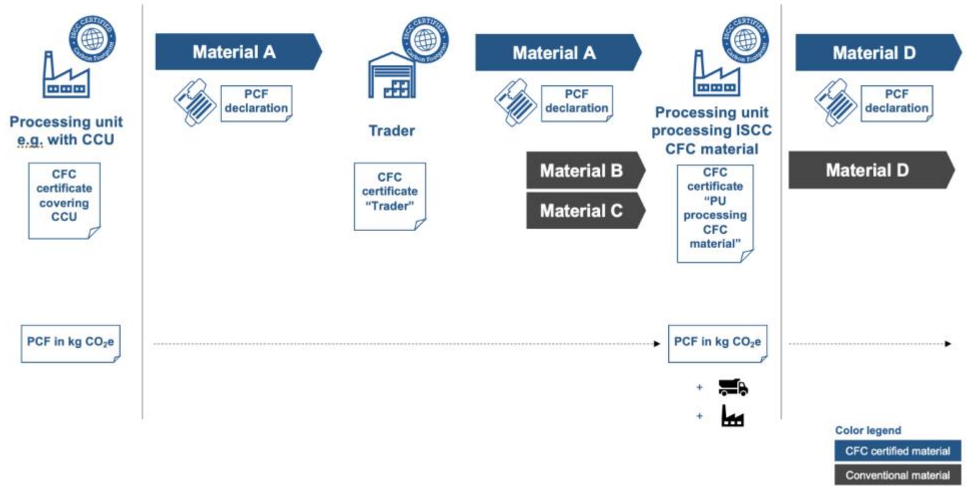

Figure 6: ISCC CFC Trader: Emissions of storage and transport needs to be considered in PCF calculation of downstream PU processing CFC material

6.1.3 Audit

Issuance of ISCC CFC certificate need to be based on a respective audit. During the audit incoming and outgoing amounts of CFC certified material need to be verified. If a trader is already ISCC PLUS certified, these traders must set up an additional mass balance for CFC certified materials. If a trader is already ISCC PLUS certified, trading entity needs to contact its CB. The setup of an additional mass balance for the ISCC CFC certified material can be verified remotely by the auditor. Issuance of ISCC CFC certificate can be handled within the certification period similar to scope expansion. Complete audit at recertification audit.

6.2 PU processing ISCC CFC material

6.2.1 Certification requirements and handling of CFC certified material

The PU processing ISCC CFC material needs to be physically supplied with ISCC CFC certified material and needs to use the CFC certified material in its production to produce a (new) product. Respective PCF claims for this (new) product can only be made under ISCC CFC, if this PU processing ISCC CFC material is certified under ISCC CFC. The downstream PU needs to have an own CFC certificate as "Processing unit processing ISCC CFC material" and receives ISCC CFC PCF declarations for its ISCC CFC certified input material and issues ISCC CFC PCF declarations for its products, which incorporate ISCC CFC certified input material.

The PU processing ISCC CFC material can be a co-processing site: CFC material is co-processed with conventional input materials of fossil origin (non-certified material) in the same assets. Due to this co-processing nature a mass balance needs to be set up to attribute CFC certified input material volumes to dedicated product volumes. To align mass balance with common LCA principles, the mass balance/ attribution needs to follow the following requirements:

1 CFC input material must be part of the input materials needed to produce the respective product (chemical/ technical feasibility).

2 Attribution of CFC input material (input feedstock) to products (output) needs to follow chemical reaction of the production. This means that the share of CFC material in the product is limited to that part of the product which is derived from specific CFC input material (no overcompensation allowed, see example in *Figure 7*).

3 Amount of CFC product is limited by amount of CFC certified input material and its consumption factor during the production of specific CFC product.

4 Material losses during production need to be considered either via consumption factor or conversion factors.

6.2.2 Emission calculation

The ISCC CFC certification of the PU processing CFC material covers the PCF calculation of its product(s) which incorporate CFC input material. The system boundaries for this PCF calculation are cradle- or gate-to-gate. Due to coprocessing nature of conducted process, separate PCFs for products of PU with and without attributed CFC input material need to be calculated (although being the same chemical/ material, see example in *Figure 7*). For the EF of the incoming batches of CFC certified input material its ISCC CFC certified PCF must be used. The PCF calculation for the products of the PU processing CFC material needs in general to follow TfS/ ISO 14067. All emissions from feedstocks/ inputs, which are physically used during production, all emissions of processing operations as well as all emission from transportation and storage need to be considered according to TfS/ ISO 14067.

6.2.3 Audit

During the audit for a PU processing ISCC CFC material it needs to be verified, if the PCF calculation of its products incorporating CFC material and the attribution of CFC input material to the respective products follow the requirements outlined in this chapter. For the verification of the mass balance the amounts of incoming CFC certified material, the conversion/ consumption factor (losses of material, chemical reaction to justify used attribution) and the amounts of outgoing products with CFC certified PCF need to be verified.

PART II: Mitigation. Technological specialties under ISCC CFC

Since the start of the certification process in 2023, ISCC CFC has been carrying out intensively supervised and jointly developed case studies. The aim of this was and is to set up transparent, reproducible, and comprehensible PCF models together with the industries and to establish a certain standard for the initial products being certified under ISCC CFC – to ensure greater comparability of the PCFs. In the following, the individual specific approaches and products are presented in detail with their modeling – all subsequent identical products from system users must follow the published approaches.

7 Carbon Capture and Storage (CCS)

7.1 Introduction

CCS is the permanent storage of CO_2 in a geological site. This emission reduction process is designed to prevent large amounts of CO_2 from being released into the atmosphere. Permanent CO_2 storing can take place in natural underground reservoirs utilizing natural geological barriers to isolate the CO_2 from the atmosphere.[10]

Three process steps

The whole process can be divided into three major steps:

- Capture: Separation of CO_2 from other gases and compression of the gas for transport purposes;
- Transport: Compressed CO_2 ("dense phase", liquid-like state) can be transported to a suitable site for geological storage e.g., via pipelines, ship or truck;
- Injection and storage: Transported CO_2 is injected into deep, underground rock formation.

CCS is an option in the portfolio of actions that could be used to reduce GHG emissions from the continued use of fossil fuels[11]. Under the ISCC CFC module, companies can get certified for the service of permanently storing CO_2. This service of storing CO_2 generates "CCS credits" in the amount of the net quantity of CO_2 being stored. The net amount is the total amount of CO_2 being stored minus the emission (CO_2) occurring for the capturing, transport, injection, and the permanent storage of the CO_2 in the geological site (CCS unit). The CCS credits being generated can be used for claims on reduced carbon emissions for fossil-based products and processes.

Under the ISCC CFC scheme, companies can consider using CCS to minimize carbon emissions of fossil-based products and to supply a more environmentally friendly product. The reduction of the CO_2 emissions for processing shall be applied to the CF of such a product. Due to the allocation of the CO_2 credits within the supply chain this approach is different from off-setting.

Applicability

This chapter provides guidelines for the certification of CCS under the ISCC CFC module and the accounting of CCS credits being generated for the permanent storage of CO_2. The requirements apply to all elements of the supply chain covering the PU from which the CO_2 is captured and the storage facility and the storage facility (CCS unit) itself. Further, this document also applies for downstream elements in the supply chain (e.g., PUs, traders) as guidelines for allocating CCS credits as well as for the avoidance of potential

[10] IPCC: Carbon dioxide transport, injection and geological storage, in: IPCC Guidelines for National Greenhouse Gas Inventories, 2006, *https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_5_Ch5_CCS.pdf*
[11] IPCC, 2006.

"double-counting" of CCS credits and carbon credits, e.g. under regulatory emission reduction schemes and ISCC simultaneously.

7.2 Certification approach for CCS supply chains

In the following the certification approach for CCS supply chains (including the respective certification requirements for the different elements of the supply chain) is described based on an exemplary supply chain including CCS (see *Figure 7*)

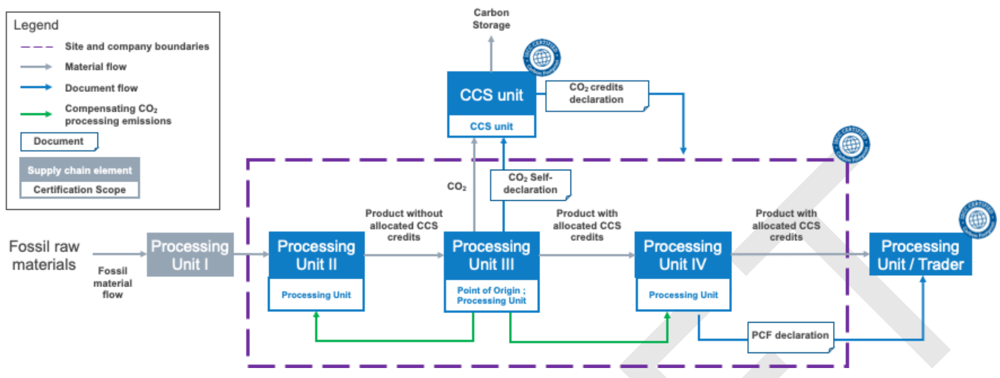

Figure 7: Example supply chain with a CCS unit in the chemical industry

7.2.1 CO_2 capturing and physical delivery to CCS unit

Point of origin is the PU capturing CO_2

The CO_2 is captured at a PU (see *Figure 7*: PU III) in the supply chain processing fossil-based raw materials and products. The CO_2 is a waste stream and without capturing the CO_2 would have been emitted to the atmosphere (direct emissions of PU III). In this example the CO_2 is of fossil (post-industrial) origin captured from industrial processes, which use fossil sources to deliberately produce electricity, heat, or materials (e.g., cement, iron and steel or the petrochemical industry). The CO_2 can also be of biogenic origin, when resulting from processing biomass at PU III.) In the example in *Figure 7* PU III is the Point of Origin (PoO) for CO_2. The captured CO_2 must be quantified and transported (e.g., via pipelines, ship, or truck) to the CCS unit. A contract must be in place for the supply of the CO_2 from the PU to the CCS unit and a respective CO_2 self-declaration must be issued. The PU generating and capturing the CO_2 needs to be certified under ISCC (certification scopes "Point of Origin" and "Processing Unit", PU III in *Figure 7*). The PoO needs to provide a CO_2 self-declaration on the captured amount of CO_2 and emission occurring for the capturing.

7.2.2 CO_2 storage at CCS unit

The CCS unit needs to be certified under ISCC (certification scope "CCS unit"). Only a certified CCS unit may issue a "CO_2 credits declaration" to the company that covers the PU generating and capturing the CO_2. In the "CO_2 credits declaration" the CCS unit confirms the amount of CCS credits, which is the amount of CO_2 permanently stored minus the amount of CO_2e emissions occurring for the capture, transport, injection, and permanent storage of the

CO_2. Additionally, the CCS unit confirms in this declaration that they do not hold any rights or credits from the CO_2 stored.

7.2.3 PU allocating the CO_2 credits

The CCS credits can be allocated to products of the PU from which the CO_2 has been captured or to products of downstream PUs, if these fulfil all following requirements:

- The downstream PU must be physically linked to the PU capturing the CO_2. Physical link means that there must be a physical flow of intermediate materials between the PU from which the CO_2 has been captured and the PU allocating CCS credits (as depicted in *Figure 7*). Additionally, the products, to which the CCS credits are allocated to must be produced via this intermediate material flow (chemical/ technical feasibility).
- The downstream PU must be operated by the company also operating the PU generating and capturing the CO_2 (within same corporate company structure).
- The downstream PU must be located on the same site as the unit capturing the CO_2 (same chemical park).

The PU allocating the CCS credits needs to be certified under ISCC (certification scope Processing Unit, PU III or IV in *Figure 7*), and can use the CCS credits within its PCF for a respective amount of outgoing product. The CCS credits can be allocated to one or several of the outputs of the PU.

If for the handling of product batches with allocated CCS credits the same infrastructure is used as for batches of the same type of product without allocated CCS credits, system users must comply with ISCC PLUS requirements for mass balancing (chain of custody option: mass balance). In comparison to the mass balancing requirements laid down in the ISCC PLUS system document, it is not allowed to conduct a multi-site-credit transfer for materials with allocated CCS credits to ensure the required physical link between the CCS unit and the products with allocated CCS credits (see description of physical link above, which is a crucial requirement for certification of CCS supply chains under ISCC CFC).

7.3 Methodology for the calculation of CCS credits

IPCC guidelines

The methodology for the calculation of CCS credits must take the IPCC guidelines into account[12]. All process steps for CCS (capturing, transport, injection, and storage) must be considered for calculating the CCS credits. For all three steps, leakages and uncontrolled CO_2 fluxes must be monitored,

[12] IPCC, 2006, *https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_5_Ch5_CCS.pdf*

measured, and considered to determine the net CO_2 storage. The following equation describes how to determine the amount of CCS credits:

Formula 1: CCS credits

$$CCS\ credits = CO_{2,stored} - E_{Capturing} - E_{Transport} - E_{Injection\ and\ storage}$$

The PU from which the CO_2 is captured must provide data for CO_2e emissions for capturing and transport. The CCS unit must provide data for CO_2e emissions for transport, injection, and storage as well as the amount of CO_2 stored. The operator of the CCS unit must provide data on annual CO_2 storage, leakages and any CO_2 fluxes through the seabed or ground surface. Additionally, the operator of the CCS unit is providing the calculation of the CCS credits.

7.4 Generation and allocation of CCS credits

Only CO_2, which is captured within the supply chain of the product the CCS credits are allocated to and transported to the CCS unit can generate CCS credits that can be allocated to the respective product. The CCS credits cannot be transferred, sold, or assigned to other supply chains under ISCC.

Site-specific PCF baseline calculation required

To evaluate the impact of the CCS credits, a cradle-to-gate PCF baseline calculation for the product(s) the CCS credits are allocated to must be provided. The PCF baseline calculation shows the PCF without consideration of any CCS credits and must be site-specific for the certified PUs (usage of primary data within this system boundaries). Therefore, site-specific PCF calculation of the intermediate products of the certified company must be available (all processes and PUs of which emissions shall be compensated as depicted in *Figure 7*) must be available. The PCF baseline calculation is verified during the ISCC CFC certification process.

The site-specific PCF baseline calculation together with the CCS credits stored via the physically connected CCS unit represent the emission inventory of the considered CCS supply chain within the system boundaries. Under the certification approach for CCS supply chains of ISCC CFC the CCS credits can be allocated to specific products of the considered CCS supply chain within this system boundaries. In other words: The CCS credits can only be assigned to products of the same production site, which uses products produced at the plant capturing the CO_2 as a material input / feedstock. The total sum of the calculated PCFs needs to be equal to the emission inventory of the supply chain within the system boundaries. Products without allocated CCS credits need to show the baseline PCF result.

Allocation limit of CCS credits

The allocation of CCS credits is only allowed to products of the processing unit, which is also the PoO of the captured CO_2, or downstream PUs of the same site and company (see *7.2.3 PU allocating the CO2 credits*). Additionally, the allocation of CCS credits is limited to compensate at most the site-specific process emissions (scope 1 and 2 as well as scope 3 of fuels used to produce energy, not scope 3 feedstock emissions) of the process units involved in the supply chain at the certified site to produce the product to which the CCS credits are allocated (emissions of PU II, III, and IV for the product of PU IV and emissions of PU II and PU III for the product of PU II in *Figure 7*). It is not allowed to compensate emissions originating upstream or downstream the site generating the CCS credits, which means that the cradle-to-gate PCF cannot be smaller than the sum of the feedstock emissions entering the system boundaries (i.e., no compensation of feedstock emissions or processing emissions outside of the site generating the CCS credits and no compensation of emissions originating from use phase or EoL).

Information on the allocation mechanism used must be transparently available for the downstream supply chain, e.g., the disclosure of the baseline PCF together with the reduction claim on the PCF declaration. The products, for which carbon reduced claims should be made, must be listed on the Annex of the certificate of the respective PU and a respective site-specific PCF baseline calculation must be in place.

Requirements on carbon balance

In all cases the balance of CCS credits stored, and CCS credits assigned must be closed, meaning that the sum of assigned CCS credits cannot exceed the amount of CCS credits stored (see calculation of CCS credits stored in *7.3 Methodology for the calculation of CCS credits*) within a mass balance period. In case the calculation of CCS credits is done on a yearly basis, a conservative estimate of the emissions from capturing, transport and injection based on the previous years can be used to determine the CCS credits for a respective mass balance period (i.e. 3 months). The balance of CCS credits needs to be reconciled, when the emissions from capturing, transport and injection are available for the respective year. Therefore, all certified entities need to conduct an individual balance of CCS credits (e.g., the CCS unit needs to conduct a balance of CCS credits stored and issued to the PU(s) allocating the CCS credits and a PU allocating CCS credits need to conduct a balance of CCS credits received from the CCS unit and allocated to its product(s)). The CCS unit needs to hold a valid ISCC certificate to generate CCS credits under ISCC CFC (CO_2 stored prior to ISCC certification cannot generate CCS credits under ISCC) and the maximum time frame for a balancing period is three months. The PU allocating CCS credits must document separately the product quantities with assigned CCS credits from product quantities without *assigned* CCS credits.

7.5 Expiration of CCS credits

CCS credits expire if they are not allocated to products after 60 months (5 years) from the month of capturing.[13] These savings can only be accounted from the first day of certification. If there is a gap between two certification

[13] In case of future restriction on credit expirations by governmental authorities, the time frame of 60 months might be subject to change

periods, any CCS credits expire. The amounts of produced material with allocated CCS credit (i.e., amounts with a reduced PCF) shall be treated on a mass balance base with a mass balance period of three months ending to each quarter of a year. It is possible to go into deficit within a mass balance period (to go short), i.e. to sell more material with a reduced PCF than is available. This, however, is only possible under the condition that at the end of the mass balance period the amount of material with the corresponding PCF generated is balanced to the amount withdrawn. If there is remaining material with a reduced PCF at the end of a mass balance period, the surplus in the bookkeeping can be transferred into the next mass balance period. At the end of a mass balance period the quantity bookkeeping either must be balanced or have a surplus in bookkeeping that can be carried forward. Transferring surpluses in the bookkeeping is possible if a valid certificate is in place. If there is a gap between two certification periods, any surpluses vanish. A negative mass balance is not permitted under ISCC and treated as a non-conformity. If a negative mass balance occurs at the end of a mass balance period, the certified company must inform the CB immediately and without being requested.

7.6 Mandatory information to be transferred within the supply chain

In the following, mandatory information is described, which needs to be transferred between different entities of the CCS supply chain (see *Figure 7*):

CO_2 self-declaration

- Information on supplier (CO_2 PoO) and recipient (CFC certified CCS unit)
- Amount of CO_2 delivered from CO_2 PoO to CCS unit
- GHG emissions related to capturing

CO_2 credits declaration

- CCS unit storing the CO_2 and issuing the CCS credits declaration (incl. address and certificate number)
- CFC certified company that covers PoO of CO_2 and is receiving the CCS credits
- Quantity of issued CCS credits
- Confirmation that CO_2 is physically received from CO_2 PoO at CCS unit, injected and permanently stored
- Confirmation that CCS unit does not hold any rights or credits from the CO_2 stored

The PCF declaration needs to give the information outlined in chapter 3. In addition, for CCS the baseline PCF of the product without the consideration of the CCS credits needs to be given. In addition, in the PCF declaration, it needs be declared, that the product with allocated CCS credits is a downstream product from the unit capturing the CO_2 (physically link between PU capturing the CO_2 and PU producing the product with allocated CCS credits)

7.7 Requirements for CCS units

CCS unit needs a valid storage permit

CCS units can be certified for the "service" of permanent CO_2 storage. A prerequisite for this is that the CCS unit has a valid storage permit issued by the respective national/ international competent authority. The CCS unit shall have implemented a quality management system or shall be monitored by the respective competent authority documenting and ensuring that[14]:

- The geological formation for CO_2 storing is defined
- The CO_2 is permanently stored
- The amount of CO_2 being stored is verified by an independent third party
- The energy consumption for CO_2 injection and storing is monitored and reported
- The injection and storage facility is monitored and the monitoring programme should include:
  - Measurement of background fluxes of CO_2
  - Continuous measurement of the mass of CO2 injected
  - Determination of CO_2 emission from injection system
  - Determination of any CO_2 fluxes through the seabed or ground surface
  - Post-injection monitoring
  - Incorporation of improvements in monitoring techniques over time
  - Regular reports by the operator to the competent authority are issued and regular inspections from third party verifiers that controlling the entire technical process of CO_2 storing are conducted

7.8 Double claiming of CO_2 credits

Double claiming of CO_2 credits is not allowed

The double claiming of environmental attributes such as CO_2 emission credits is not allowed under ISCC. The amount of CO_2 emission credits being generated via the storage of CO_2 in the CCS unit can only be assigned to one defined volume of material under ISCC. The same CCS credit can hence not be assigned twice or multiple times to different products of the supply chain. The CCS credits can also not be separated, transferred, or sold individually without the product they were assigned to. Thus, in case the CCS credits are

[14] Requirements in line with DIR 2009/31/EC on the geological storage of CO_2

used under ISCC, those cannot be used to generate e.g., carbon credits on the voluntary market.

8 Carbon Capture and Utilization (CCU)

Introduction to CCU

CCU refers to technologies and processes that capture CO_2 emissions from industrial sources or directly from the atmosphere and convert it into useful products or energy sources. Unlike CCS, where the captured CO_2 is stored underground, CCU focuses on repurposing the CO_2. CCU can contribute to emission reductions by capturing CO_2 from existing point sources of emissions and consequently avoiding the release into the atmosphere and/ or by substituting products or energy carriers with CCU products.

The relevant steps for CCU can by structured as follows:

- Capture and upgrading: Capturing and compression of CO_2.
- Transport: If the compressed CO_2 is not used onsite, it is transported to another production unit or entity, where it is used as an input to produce another product (e.g., synthetic fuels, chemicals, building materials, etc.).
- Utilization: The CO_2 is used as an input and (partly) converted into a product or an energy carrier. During this process, the previously captured CO_2 might be converted completely or partly, with the share of unconverted CO_2 being released into the atmosphere or captured again.
- Downstream processes and EoL: The produced product might be further processed in downstream activities. Finally, at the end of the lifetime of the product, it might be burned (e.g., for energy production) or recycled.

CCU is discussed as an emission reduction measure, complementing the use of renewable energy and efficiency improvements, though its scalability and long-term sustainability depends on technological advancements and the market demand for CO_2-based products.

Applicability

Under the ISCC CFC module, benefits from CCU activities can be integrated in PCF calculations. This can include the effect of capturing CO_2 on the process which had previously emitted the CO_2, as well as the PCF of products produced from captured CO_2. A core element in this regard is the balance and the flow of the captured CO_2 from the capturing process over the conversion into new materials and products until the final release of CO_2 into the atmosphere at the EoL of the CCU product. The benefit from capturing CO_2 can be determined by considering the amount of captured CO_2, the emissions associated with the capturing process and the transport of the CO_2, the amount of CO_2 or carbon which is stored in a CCU product, potential emissions from unconverted CO_2 into the atmosphere, and finally, the release of CO_2 at the EoL of the CCU product. ISCC CFC allows for different ways to allocate the PCF benefits of CCU activities between the capturing unit and the unit producing the CCU product.

This chapter provides guidelines for the certification of PCFs for CCU based products under the ISCC CFC module. The requirements of the certification approach apply to the described supply chain elements, covering the PU from which the CO_2 is captured (capturing unit), the transport of the captured CO_2 to the downstream PU incorporating the CO_2 (CO_2 User) as well as the EoL of the CCU product.

8.1 Certification approach for PCF involving CCU activities

This section describes the certification approach for the PCF of CCU products.

Elements of CCU value chains relevant for the PCF certification

As depicted in *Figure 8*, the certification of the PCF of the CCU product covers two processing units (PUs): One PU with attached CO_2 capturing unit and one PU converting the CO_2 to the CCU product. The PU capturing the CO_2 will be the CO_2 PoO and the PU converting the CO_2 into CCU products is the Collecting Point (CP) of the CO_2.

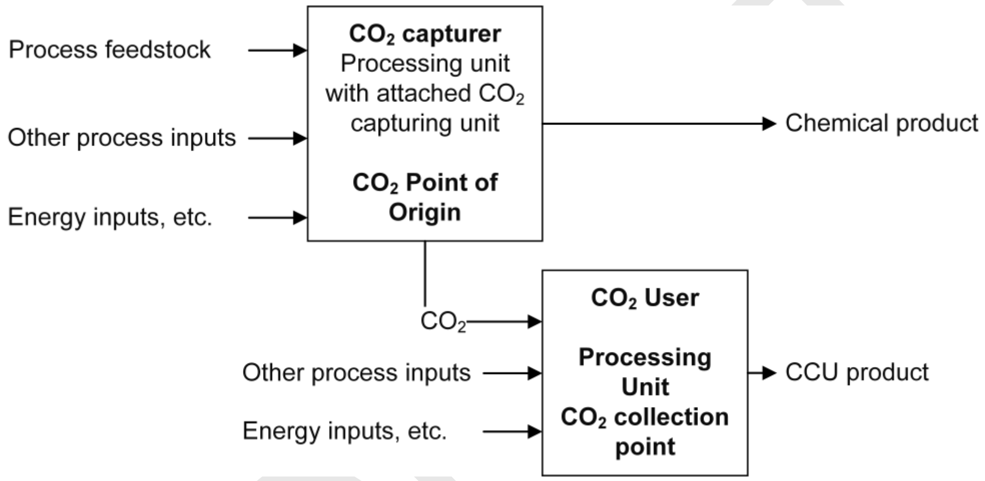

Figure 8: Covered elements of CCU supply chain

8.1.1 CO_2 capturing and subsequent supply to a PU

The CO_2 is captured at the CO_2 PoO (see *Figure 8)*. The CO_2 is a waste stream and without capturing the CO_2 would have been emitted to the atmosphere. In general, the CO_2 can be of fossil or biogenic origin (see *8.1.2 Eligible CO2 sources*). The captured CO_2 must be quantified and transported (e.g., via pipelines, ship, or truck) to the subsequent unit which produces the CCU product (CO_2 User, Collecting Point). The PoO issues a self-declaration for the collecting point. This CO_2 self-declaration includes information on the captured CO_2 and a statement, whether the benefit of the emission capturing has already been integrated into the PCF calculation for the products at the PU which has emitted the CO_2 (100:0 or 0:100 approach, see chapter "The 100:0 and 0:100 CCU approaches"). This decision and the corresponding statements define the consideration of the climate impacts of the CCU CO_2 in the PCF of the CCU product.

ISCC provides templates for the ISCC documents issued within the supply chain. The information to be included in the declarations are further specified in *8.1.4 Certification concept for the CO2 benefit in PCF calculations*.

8.1.2 Eligible CO_2 sources

The CCU CO_2 used in the downstream PU producing the CCU product needs to come from one of the following eligible sources:

Three eligible sources of CO_2

- Atmospheric CO_2 from direct air capture (eligible for CCU 0:100).
- Post-industrial (fossil) CO_2 captured from industrial processes, which use fossil sources to deliberately produce electricity, heat, or materials (e.g., cement, iron and steel, petrochemical industry) and would have otherwise been emitted to the atmosphere.
- Biogenic CO_2 which originates from biomass. The biomass must originate from sustainable sources, verified by a certification scheme recognized under the renewable energy directive framework or equivalent standards. Disclaimer: The explicit assessment methodology of biogenic carbon will follow in the next system document update.

CO_2 produced deliberately for the usage in the CCU process is not eligible under this CCU certification approach of ISCC CFC.

8.1.3 CCU products

The certification of PCFs at the PU producing CCU products covers the PCF of the products produced from the CCU CO_2. This includes the verification of the eligibility of the CCU CO_2 and the plausibilisation and verification of the calculated PCF of the CCU products (see 8.1.4 *Certification concept for the CO2 benefit in PCF calculations*)

8.1.4 Certification concept for the CO_2 benefit in PCF calculations

Capturing and utilizing CO_2 emissions can provide benefits in the PCFs of products produced at the processing unit with attached capturing unit or at the PU which converts the captured CO_2.

The ISCC CFC approach allows for two options to incorporate the benefit of the CO_2 capturing:

ISCC CFC considers two approaches to integrate CCU benefits in PCFs

- 100:0. The benefit of capturing the emissions is claimed by the processing unit with attached capturing unit (e.g., it is integrated into the PCF of the products of this unit)
- 0:100. The benefit is claimed by the unit producing the CCU product and it is integrated into the PCF of the CCU product.

8.1.4.1 The 100:0 and 0:100 CCU approaches

The capturing unit claims the benefit under 100:0

In the **100:0 approach**, the capturer of the CCU CO_2 considers their process CO_2 emissions as captured and not emitted. The CO_2 capturer can then allocate CCU credits (amount of emissions eligible to be accounted towards reducing PCF at the CO_2 capturer unit) to dedicated product volumes thereby reducing the PCF of their own produced products. The CCU credits are limited to the amount of captured carbon, minus the emissions from the capturing process[15]. The PCFs at the capturing unit can be reduced in maximum by that part of the PCF, which is coming from process emissions, along the direct value chain on the same site as the CO_2 source. (*Figure 9*)

Any accounting of reductions towards upstream emissions (i.e., feedstock extraction emissions) to reduce the PCF is not possible. The products with reduced PCF need to be produced in a process whose process emissions were captured. In the 100:0 approach the CO_2 does not carry a CCU credit. Hence the user cannot claim any emission benefit from incorporating the CO_2 in their production.

The user of the captured CO_2 claims the benefit under 0:100

In the **0:100** approach, the capturer of the CO_2 considers their captured process CO_2 emissions as emitted, and the captured CO_2 carries a CCU credit[16]. The following processing entity using the captured CO_2 can reduce the PCF of the user products by the amount of incorporated CO_2. (*Figure 9*)

Under both activities, the credits for the CO_2 benefit of the CCU activity can be assigned to a specific product and can either be stated separately or already included in the PCF. It must be claimed, which of those two options is applied.

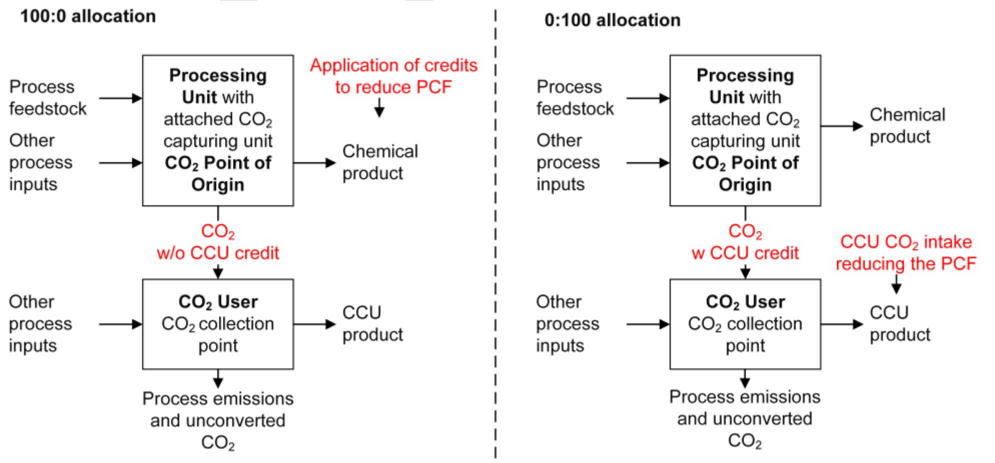

Figure 9: 100:0 and 0:100 approach – handling emissions and credits

---

[15] The emission burdens associated with the capturing of the CO_2 need to be considered in the PCF calculation of the capturer unit for the 100:0 approach.

[16] In case of the 0:100 approach the emission burdens associated with the capturing of the CO_2 need to be considered in the PCF calculation of the user unit.

8.1.4.2 Integration of the 100:0 and 0:100 approach in the PCF certification

In case of the 100:0 and the 0:100 approach the unit, which considers the CO_2 credit in the PCF calculation and wants to claim reduced PCFs for their products, need to be certified under ISCC CFC and a proper documentation of the consideration of the CO_2 credit need to be applied to avoid double counting of the CO_2 credit (see *Figure 10*).

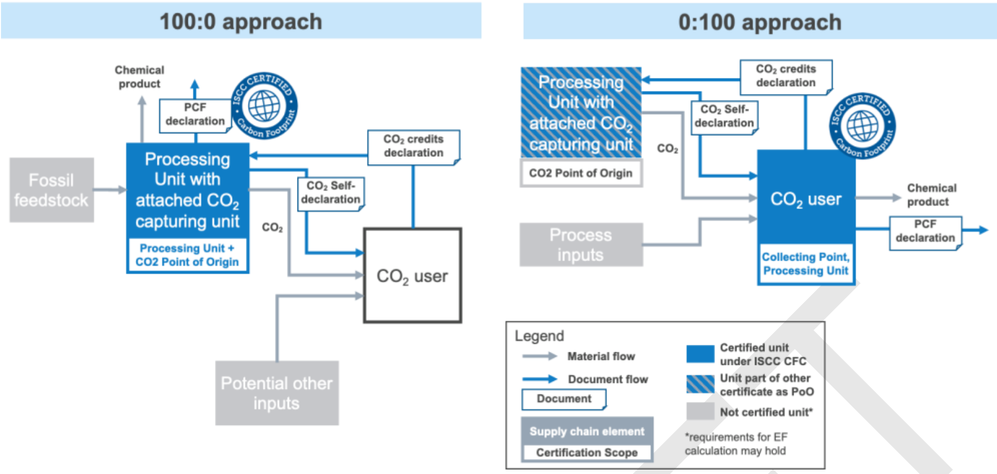

Figure 10: Certification concepts for 0:100 and 100:0 approaches

For the 0:100 approach the CO_2 user unit needs to be certified under the scopes “Collecting Point” and “Processing Unit” (*Figure 10*). The PU capturing the process CO_2 emissions will be the CO_2 PoO and can be covered under the collecting point certificate of the CO_2 user unit. The PoO issues a self-declaration to the collecting point. This CO_2 self-declaration includes information on the captured CO_2 and a confirmation that the CO_2 credit for the CO_2 captured and transported to the user unit has not been considered already in the PCF calculation for the products at the PU which emits the CO_2. All PoOs will be audited during the collecting point audit of the CO_2 user unit. The auditor of the user unit needs to be able to verify at the capturing unit, that the CO_2 credit has not already been considered in PCF calculation of the capturing unit products. In the CO_2 credits declaration the user confirms the application of the credit for the incorporated CO_2.

An alternative certification concept for the CO_2 supply in the 0:100 approach to the CO_2 user may be via a separately ISCC PLUS certified “Collecting Point” (collecting the CO_2 from associated PoOs with respective CO_2 self-declarations) or ISCC PLUS certified “Trader”. In this case the CO_2 user would only be certified as “Processing Unit” under CFC and receive the CO_2 from the ISCC PLUS certified “Collecting Point” or “Trader” with an ISCC PLUS sustainability declaration.

For the 100:0 approach the PU with attached CO_2 capturing unit needs to be certified under ISCC CFC. The CO_2 is physically transported from the capturer unit to the user without a credit. In this approach a verification at the CO_2 user is needed to ensure that the CO_2 is (a) incorporated into products produced at the user unit and (b) that there is no credit applied for the incorporated CO_2 in the PCF calculation of the user unit products. This can be ensured, if the user unit is also CFC certified and a respective verification happens at the audit of the user unit. Alternatively, if the user unit has no own CFC certification, the user shall be able to show the auditor during the audit of the capturing unit products, that (a) and (b) is fulfilled for the respective amounts of CO_2 transported from capturer to user without a credit. In addition, the user unit issues a self-declaration to the CO_2 capturing unit, declaring that the user unit does not consider any credits in their own PCF calculation for the incorporated CO_2 (CO_2 credits declaration).

The documents shared within the supply chain need to provide the following information:

CO_2 self-declaration

- Information on supplier (CO_2 PoO) and recipient (CO_2 User)
- Information on CO_2 source
- Amount of CO_2 delivered from CO_2 PoO to CO_2 Collecting Point (CO_2 User)
- GHG emissions related to CO_2 capturing
- Delivered CO_2 amount, with CCU credit already applied at the capturer (100:0, CO_2 forwarded without CCU credit)
- Delivered CO_2 amount, whose CCU credit has not been applied at the capturer (0:100, CO_2 forwarded with CCU credit)

CO_2 credits declaration

- Information on supplier (CO_2 PoO) and recipient (CO_2 User)
- Amount of delivered CO_2 from the capturer, that has been incorporated into products produced at the user unit without the consideration of a CCU credit in the PCF calculations of the products produced at the user unit (100:0). Potential amounts of unconverted CO_2 need to be deducted.
- Amount of delivered CO_2 from the capturer, that has been incorporated into products produced at the user unit with considered CCU credit in the PCF calculations of the products produced at the user unit (0:100).

The PCF declaration needs to give the information outlined in chapter 3. In addition, for CCU the baseline PCF of the product without the consideration of the CO_2 credits needs to be given.

Expiration of CCU credits

CCU credits expire if they are not allocated to products 60 months (5 years) from the month of capturing.[17] These credits can only be accounted from the first day of certification. If there is a gap between two certification periods, any CCU credits expire. The amounts of produced material with allocated CCU credit (i.e., amounts with a reduced PCF) shall be treated on a mass balance base with a mass balance period of three months ending to each quarter of a year. It is possible to go into deficit within a mass balance period (to go short), i.e. to sell more material with a reduced PCF than is available. This, however, is only possible under the condition that at the end of the mass balance period the amount of material with the corresponding PCF generated is balanced to the amount withdrawn. If there is remaining material with a reduced PCF at the end of a mass balance period, the surplus in the bookkeeping can be transferred into the next mass balance period. At the end of a mass balance period the quantity bookkeeping either must be balanced or have a surplus in bookkeeping that can be carried forward. Transferring surpluses in the bookkeeping is possible if a valid certificate is in place. If there is a gap between two certification periods, any surpluses vanish. A negative mass balance is not permitted under ISCC and treated as a non-conformity. If a negative mass balance occurs at the end of a mass balance period, the certified company must inform the CB immediately and without being requested.
It is not allowed to conduct a multi-site-credit transfer for materials with assigned CCU credits.

8.1.4.3 CO_2 mass balance system and two-PCF-approach for CO_2 capturing unit

A CO_2 mass balance for different types of process emissions supports the verification

Due to different options for claiming the CO_2 credit, the capturer of CO_2 shall maintain a CO_2 mass balancing system that accounts for different categories of process CO_2 emissions. As depicted in *Figure 11*, the CO_2 mass balance system at the CO_2 capturer's end, shall evaluate if their process CO_2 emissions need to be considered as a) emitted or b) 100:0 CO_2 (without credit) or c) 0:100 CO_2 (with credit). CO_2 which has been captured but emitted again due to the absence of a user (case a above), needs to be accounted in the PCF calculation of the capturing unit including the emissions associated with the capturing step.

[17] In case of future restriction on credit expirations by governmental authorities, the time frame of 60 months might be subject to change.

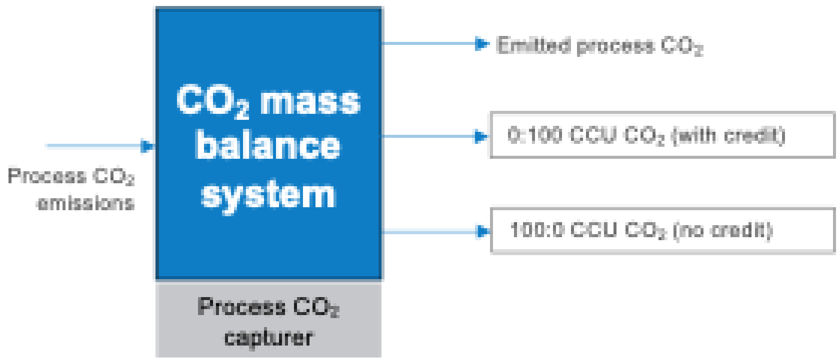

Figure 11: Flow chart of potential CO_2 emissions, utilization with or without a credit at the CO_2 capturing unit

Since the CO_2 can be send to the user unit either under 100:0 or 0:100 approach, the products of the capturer of the process CO_2 emissions can have two different CF values. Therefore, a baseline and an optimized PCF for products at the capturing unit shall be implemented. The assessment of the PCFs follows ISO 14040/ 44/ 67 and TfS, and the methodological guidelines defined in this document.

Baseline and reduced PCFs

A so-called baseline PCF does not include any credits for the captured CO_2. For product volumes associated with this baseline PCF, the full process emissions per kg of product need to be considered, leading to higher emissions compared to the reduced PCF. The optimized PCF (PCF, incl. credits) considers the benefit of captured CO_2 process emissions, leading to a PCF with reduced process emissions. The two-PCF-approach hence exhibits two distinct PCFs for the same product of the capturing unit: one considering the default processing emissions at the unit capturing the CO_2 (baseline PCF) and one considering the reduced processing emissions at the unit capturing the CO_2 (reduced PCF) (see *Figure 12*).

The CO_2 mass balance system at the capturing unit is used to determine the amount of product that can be sold with the optimized PCF at the CO_2 capturing unit. Only captured CO_2 transported without a credit to a user, who incorporates this CO_2 in their products and does not consider the CO_2 credit in their own PCF calculation, generates CO_2 credits at the capturer. These credits can be assigned to product volumes at the capturing unit to reduce their PCF by the amount of processing emissions (100:0 approach).

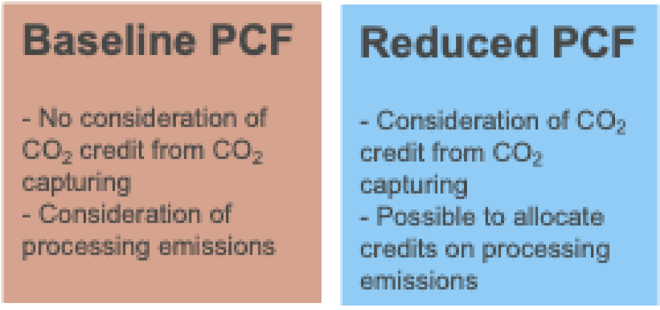

Figure 12: Schematics of a 2-PCF approach for products with and without consideration of process emissions at the capturing unit – guided by ISO 14040/ 44/ 67 and TfS

8.2 Methodology for the calculation of the CF of products

The assignment of the CCU benefits under 100:0 and 0:100 follows different procedures

This chapter defines specifications in the calculation of the PCF for CCU products and includes guidance for the allocation of the CCU benefit under the 100:0 and 0:100 approaches. *Figure 13* introduces the basic calculation procedures for the incorporation of the CCU benefit in the CF of the products produced at the CO_2 PoO (left side of the calculation tree) or the CCU utilizing unit (right side of the calculation tree).

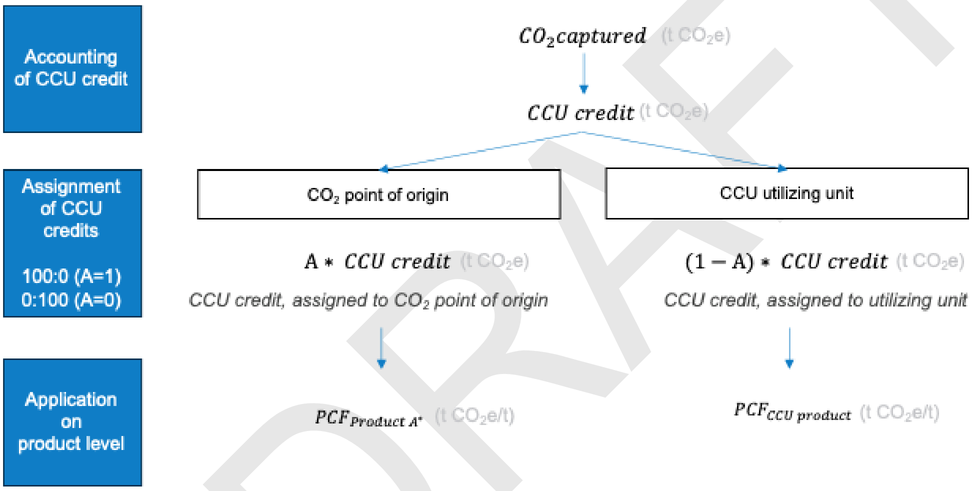

Figure 13: Calculation tree for application of CCU credits on PCFs

Both approaches as well as the parameters included in *Figure 13* are further defined and explained in the following paragraphs.

8.2.1 Accounting of CCU credits

At first, the amount of CO_2 captured and utilized/incorporated in CCU products ($CO_2captured$) must be identified and documented in t CO_2e.

Calculating the CCU credit

To calculate the CCU credit (in t CO_2e), *Formula 2* shall be applied. Thereby, the CCU credit comprises the $CO_2captured$ as negative and adds on the upstream emissions as burdens, lowering the CCU credit slightly. The upstream emissions include emissions for the capturing, compressing and further inputs needed for the concentration of CO_2, as well as process related emissions. The CCU credit can be calculated on a yearly basis. It is important to set the time frame once and stay with the chosen period throughout the entire calculation.

Formula 2: CCU credit

$$CCU\ credit = -CO_2captured + E_{CCU\ CO_2upstream\ emissions}$$

$CCU\ credit$	*Credit, considering the amount of captured and utilized CO_2, minus the upstream emissions* *[t CO_2e / e.g., year, certification period]*
$CO_2captured$	*Amount of captured of CO_2 [t CO_2e]* *This term represents a credit for the avoided emissions from capturing the CO_2 (see 8.1.4.1).*
$E_{CCU\ CO_2upstream\ emissions}$	*Emissions from capturing and supply of the CCU CO_2 to the CCU product PU [t CO_2e]* *This includes emissions from the use of energy for CO_2 capturing, compressing, the production and use of process chemicals for purification/ concentration of the CO_2 as well as the transport of CCU CO_2.*

8.2.2 Assignment of credits under 100:0 and 0:100

Allocation limits of CCU credits

In the second step, the CCU credit is assigned to either the site of the CO_2 PoO (100:0) or to the site, where the captured CO_2 is utilized (0:100).

One substantial difference in that regard is that, while in the 100:0 approach, the credit can be allocated to processing emissions of different products, which are physically connected and downstream the capturing unit (compare *Figure* 14). The conditions for allocation of credits are the same as under CCS (see *7.4 Generation and allocation of CCS credits*). The assignment of the credit for CCU products (0:100) is based on the amount of CCU CO_2 which is incorporated in the CCU product.

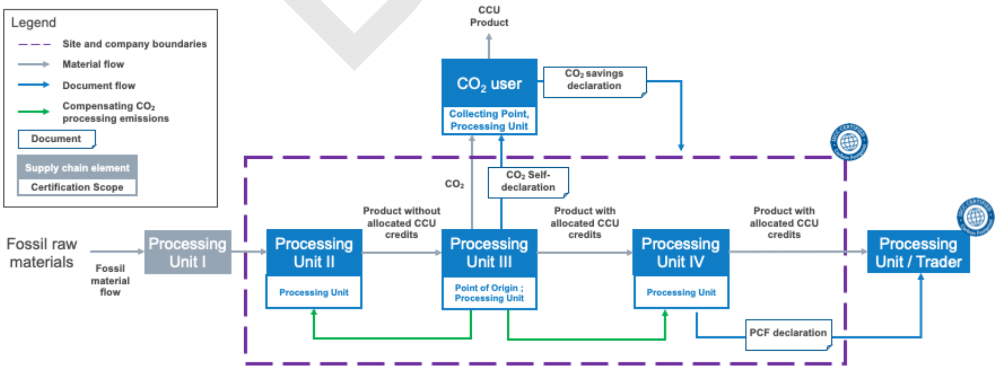

Figure 14: Assignment of credits and flow of documentation for the PCF calculation of CCU value chains

To allocate the CCU credit in-between those two entities, the allocation factor A is applied. The following formulas can then be used to assign the CCU credits.

Formula 3: Assignment of CCU credits to CO_2 PoO

$$CCU\ credit, assigned\ to\ CO_2\ point\ of\ origin = A * \ CCU\ credit$$

and

Formula 4: Assignment of CCU credits to CCU utilizing unit

$$CCU\ credit, assigned\ to\ CCU\ utilizing\ unit = (1 - A) * \ CCU\ credit$$

A	*Allocation factor, to allocate the CCU credit to the CO_2 point of origin or to the CCU utilizing unit [-]* $A = 1$, *for the 100:0 approach and* $A = 0$ *for the 0:100 approach.*

8.2.3 Application of CCU credits on product level and PCF calculation

In the third step, the credits are applied at the product level. Starting with the 100:0 approach, left side of *Figure 13*, *Formula 5* explains how to calculate the PCF of product A^*, whereby product A^* is produced downstream at the same site, as the CO_2 PoO (see *8.1.4.2 Integration of the 100:0 and 0:100 approach in the PCF certification*).

In this case, the $Applied\ CCU\ credit$ covers the CCU credit, which can be applied to the PCF of product A^*. Unlike before, the $Applied\ CCU\ credit$ is no longer referring to the total amount of CCU credit but is set in relation to the mass of product A^*. To avoid double counting, the total $Applied\ CCU\ credit$ cannot exceed $(A * CCU\ credit)$. Furthermore, the $Applied\ CCU\ credit$ can only be applied to the processing emissions of product A* ($E_{P_{A^*}}$), and therefore must be smaller or equal $E_{P_{A^*}}$.

$E_{P_{A^*}}$ is covering the emissions from the process emissions of the CO_2 utilisation site, namely production, supply and use of process inputs like process chemicals, process energy or energy carriers (in other words emissions covered under scope 1 and 2 of corporate sustainability accounting frameworks.

Formula 5: Simplified Example Product A^* on site (CO_2 source of origin)

$$PCF_{Product\ A^*} = \left(Applied\ CCU\ credit + E_{P_{A^*}}\right) + E_{Feedstock\ for\ A^*}$$

with

$$Mass_{ProductA^*}(t\ of\ product) * Applied\ CCU\ credit(t\ CO_2e/t\ of\ product) \leq A * CCU\ credit\ (tCO_2e)$$
$$\Leftrightarrow$$
$$Applied\ CCU\ credit\ \leq A * CCU\ credit/Mass_{ProductA^*}$$

$PCF_{Product\ A^*}$	*Emissions, related to the production of A^** *[t CO_2e / t of product]* *The necessary condition for A^*: Same site and downstream of capturing unit.*
$Applied\ CCU\ credit$	*The CCU credit [t CO_2 / t] must fulfill the following conditions:* • *The applied CCU credit cannot exceed the emissions for processing of P_{A^*}:* $$Applied\ CCU\ credit\ \leq E_{P_{A^*}}$$ • *And the total applied CCU credit cannot exceed the CCU credit, which has been assigned to the site at CO_2 source of origin:* $$Mass_{ProductA^*} * Applied\ CCU\ credit\ \leq A * CCU\ credit$$ $$\Leftrightarrow$$ $$Applied\ CCU\ credit\ \leq A * CCU\ credit/Mass_{ProductA^*}$$
$E_{P_{A^*}}$	*Emissions, related to processes to produce A^*, which can cover several process units on that side.* *[t CO_2e / t of product]* *This includes emissions from the use of process inputs such as energy, or process chemicals and the upstream emissions associated with their production and supply. Furthermore, direct process emissions shall be included here. This covers emissions accounted under scope 1 and 2 in corporate sustainability accounting frameworks*
$E_{Feedstock\ for\ A^*}$	*Emissions, related to feedstock inputs for A^*, entering the site* *[t CO_2e / t of product]*

Under the 0:100 approach, (right side of *Figure 13*), the entity, where the CO_2 is incorporated in the CCU product, shall calculate the PCF of the CCU product as shown in *Formula 6*.

To calculate $PCF_{CCU\ product}$, three parameters must be considered. The $Incorporated\ CCU\ credit$ determines the amount of CO_2, which is incorporated in the CCU product. In addition, it must be ensured that $Mass_{CCU\ Product}$ times $Incorporated\ CCU\ credit$, which is measured in tCO_2e per $t\ of\ product$, does not exceed the credits, that have been assigned to that entity ($(1 - A) * CCU\ credit$).

Additionally, the emissions to produce the CCU product, without any credit accounting ($E_{CCU\ product}$) must be included. *Formula 7* provides guidance on how to calculate $E_{CCU\ product}$. Lastly, the emissions referring to the unconverted CO_2 ($E_{unconverted\ CCU\ CO_2}$) must be added.

Formula 6: Emissions of the CCU product

$$PCF_{CCU\ product} = Incorporated\ CCU\ credit + E_{CCU\ product} + E_{unconverted\ CCU\ CO_2}$$

$PCF_{CCU\ product}$	*Emissions from the production of the CCU product [t CO_2e / t]*
$Incorporated\ CCU\ credit$	*The* $Incorporated\ CCU\ credit$ *[t CO_2 / t] comprises the amount of incorporated CO_2 in the specific CCU product.* *And must fulfill:* $Mass_{CCU\ Product} * Incorporated\ CCU\ credit \leq (1 - A) * CCU\ credit$
$E_{CCU\ product}$	*See Formula 7 below.*
$E_{unconverted\ CCU\ CO_2}$	*This term shall consider process emissions of excess CCU CO_2, not converted into a CCU product (and released to the atmosphere) [t CO_2e / t]*

The emissions from production of the CCU product ($E_{CCU\ product}$) shall be calculated as depicted in *Formula 7*. In general, $E_{CCU\ product}$ shall cover feedstock ($E_{Feedstock}$), as well as processing emissions (E_P), necessary to produce the CCU product.

Formula 7: Emissions from production of the CCU product

$$E_{CCU\ product} = E_{Feedstock} + E_P$$

$E_{CCU\ product}$	*Emissions from the production of the CCU product, without any credit accounting [t CO_2e / t]*
$E_{Feedstock}$	*Emissions, related to feedstock inputs for the CCU product, entering the site [t CO_2e / t of product]*
E_P	*Emissions, related to processes to produce the CCU product, which can cover several process units on that side. This includes emissions from the use of process inputs such as energy, or process chemicals and the upstream emissions associated with their production and supply. Furthermore, direct process emissions shall be included here. This covers emissions accounted under scope 1 and 2 in corporate sustainability accounting frameworks [t CO_2e / t of product]*

Finally, when the CCU products are further processed or used downstream, it is important to include the re-release of the CCU CO_2 which bound in the CCU product in the PCF of downstream products or applications (e.g. in cradle-to-grave assessments).

8.2.4 Allocation

In case the process which converted the captured CO_2 is a multi-output process, the GHG emissions calculated with the approach described in 8.2 *Methodology for the calculation of the CF of products* shall be allocated between the process products. A prerequisite for the consideration of heat as a product is that the heat is utilized in other processes. Emissions from downstream processing or transport and distribution emissions of the CCU product cannot be added prior to allocation, as those emissions are not related to the co-products. The allocation of GHG emissions to any products that are considered waste or residue is not permitted[18].

The CO_2 credit can only be allocated under certain preconditions

Additionally, the allocation of the CCU credit is only possible, in case carbon of the CCU CO_2 has also been fixated in these co-products and, in case the 0:100 approach has been chosen.

The general approach to allocate the calculated emissions to all eligible process outputs, shall follow the requirements and procedures defined in *4.1.6 Allocation*. One example is the allocation involved in the calculation of H_2 from syngas processes. For this process, the allocation between H_2 and potential co-products shall be based on the LHV.

Additionally, in case the carbon of the captured CCU CO_2 is fixated in both, main and co-product, the credit calculated under the term $Incorporated\ CCU\ credit$ shall be allocated based on a mass balance considering the masses of the CO_2 intake into the process and the amount of fixated carbon in main and BP.

8.2.5 Data basis

The PCF calculation is based on actual data gathered from the ISCC system user and data sourced from databases and literature.

Data gathering is relevant for the process inputs defined in the PCF calculation equation in *4.2 Data as the basis – LCI* including e.g. energy consumption, other process inputs and output data like process emissions, wastes, products and BPs. Relevant parameters, which cannot be measured directly, shall be calculated based on the input and output flows of the process. When gathering the on-site data, the requirements in *4.2.1 Data categories* shall be followed. In addition, the source and amount of CO_2 captured and utilized must be measured.

Published data

Sources for published EFs or additional information to support the PCF calculations are described under section 4.2 *Data as the basis – LCI.*

[18] For the classification of waste and residues, please refer to ISCC 202-5

8.3 An example PCF for CCU MeOH (0:100)

The following section provides an example for the application of the CFC CCU methodology to the production of MeOH from CCU CO_2. This example is based on the assumption, that the CO_2 benefit of the CO_2 capturing effort is claimed by CO_2 user (0:100 approach).

8.3.1 Introduction

Methanol (MeOH) is a high-volume commodity chemical. It is a precursor to several important industrial chemicals such as formaldehyde, acetic acid, methyl tertiary-butyl ether (MTBE) and dimethyl ether (DME). Global installed MeOH production capacity has been growing since 2009 with an average annual rate of about 10%, while the production has been also growing at a slightly smaller rate, around 7%, reaching 58 Mt in 2012, according to the IEA or 60.6 Mt according to the MeOH Market Services Asia (MMSA).
MeOH is typically produced from pressurized synthesis gas (or syngas, a mixture of mainly hydrogen (H_2,) CO and CO_2), which reacts in the presence of a catalyst, according to:

Formula 8: Reaction equation of methanol

$$CO + 2H_2 \rightarrow CH_3OH$$

The reaction is highly exothermic, and a major challenge is the removal of excess heat, in order to shift the equilibrium towards the products and avoid side reactions and catalyst sintering. Syngas can be produced either by steam reforming in the case of light hydrocarbons, such as natural gas or light naphtha, or by partial oxidation, in the case of heavy oils or solid carbonaceous materials.

CCU represents a new economy for CO_2, since captured CO_2 can be used as raw material for other processes. This includes the synthesis of chemicals and materials (such as MeOH, formic acid, polyols for polyurethanes, carbonates), fuels (like CH_4 or kerosene) and direct use in applications based on CO_2 physico-chemical properties (for example in supercritical state). To produce hydrocarbons from CO_2 the carbon atom of CO_2 needs to be reduced, which requires energy – again leading to another output of CO_2 and other GHGs. The consumption of energy in CCU processes is hence important and must be considered to compare the CCU process with the conventional production of the respective product, regarding emitted CO_2e and needed energy. Therefore, in this certification approach requirements will be described to calculate a cradle-to-gate (resource extraction until company gate) PCF for CCU MeOH.

During the conventional MeOH production, CO_2 is formed in the syngas production process. This CO_2 being part of the syngas during a conventional production process of MeOH cannot be considered as an eligible CO_2 source under this certification approach. Hence the respective part of a conventional

MeOH production originating from this CO_2 being part of the conventional syngas cannot be considered as CCU MeOH under this approach.

8.3.2 Eligible H_2 sources

The used H_2 in this certification approach can originate from fossil sources (e.g., natural gas), but needs to be produced together with other products from the used fossil source (e.g., excess H_2 as part of a flue gas stream from the production of conventional MeOH, H_2 from syngas production with co-product CO). Dedicated production processes, which produce H_2 from fossil sources as the only product with all the carbon of the fossil feedstock being released as CO_2 to the atmosphere are not eligible under this approach (e.g., H_2 from natural gas or coal with all carbon of the fossil feedstock being vented as CO_2). So called “blue hydrogen” with all carbon emissions originating from the fossil feedstock during the H_2 production being stored permanently via CCS is an eligible H_2 source under this certification approach (e.g., H_2 with certified net-zero PCF under the CCS certification approach of the ISCC Carbon Footprint Module[19]).

8.3.3 Methodology for the PCF calculation of CCU MeOH

This chapter defines specifications in the calculation of the PCF of CCU MeOH as well as the necessary verification of PCF calculations for CCU MeOH under ISCC CFC. For the case of CCU MeOH in this chapter, we assume that a 0:100 approach has been selected, assigning the benefit of the CCU activity to the CCU MeOH production.

The calculation of GHG emissions for CCU MeOH production shall consider the direct emissions of the MeOH production process, the upstream emissions associated with the production and the supply of process inputs such as electric energy, feedstock input to the process (e.g., syngas with its specific composition), process heat, captured CO_2, used as a process input, other process chemicals as well as potential co-products of the process. The GHG calculation needs to be performed on a yearly basis (preferred 12 months prior to certification) and shall be updated prior to recertification. The PCF calculated is valid for the validity period of the certificate (1 year) if no major changes for the PCF are expected e.g. by significant process changes.

Figure 15 shows a simplified process flow figure with the relevant parameters for the calculation.

[19] ISO 14067 compliant assignment of CO_2 credits required, see documentation of CCS certification approach.

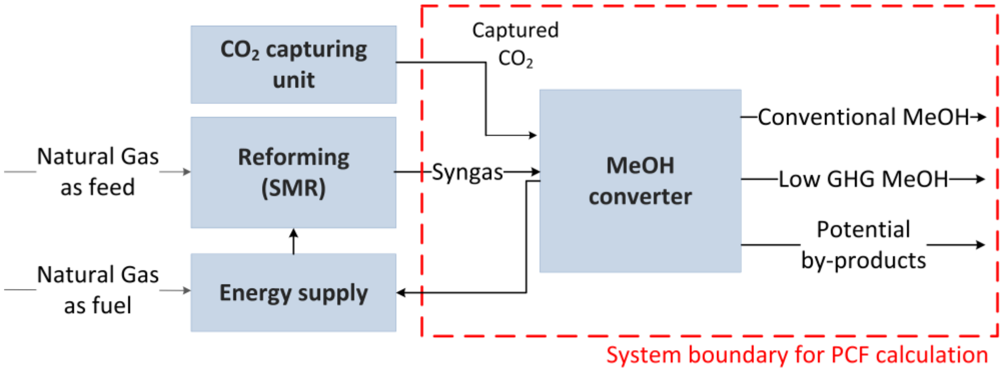

Figure 15 Main parameters for the PCF calculation of MeOH Production

8.3.3.1 PCF calculation for CCU MeOH

The calculation of the CCU MeOH PCF follows the methodology defined in *8.2 Methodology for the calculation of the CF of products*.

At first, the total amount of CCU credit is calculated according to *Formula 2*.

Formula 8: CCU credit of CCU methanol

$$CCU\ credit = -CO_2\ captured\ + E_{CCU\ CO_2 upstream\ emissions}$$

$CO_2\ captured$	*Amount of captured of CO_2, directly related to the production of the CCU MeOH product [t CO_2e] This term represents a credit for the avoided emissions from capturing the CO_2 (see 8.1.4.1). The credit is limited to the amount of captured CO_2, which is introduced into the process for the CCU product.*
$E_{CCU\ CO_2 upstream\ emissions}$	*Emissions from capturing and supply of the CCU CO_2 to the CCU MeOH PU [t CO_2e] This includes emissions from the use of energy for CO_2 capturing, compressing, the production and use of process chemicals for purification/ concentration of the CO_2 as well as the transport of CCU CO_2.*

In the second step, the CCU credit, assigned to the CCU utilizing unit is determined. As defined before, the 0:100 has been selected. Therefore, the allocation factor is set 0 and *Formula 4* is applied.

With this, the PCF of CCU MeOH can be calculated in a third step. *Formula 9* shows the application of *Formula 6* on the example of CCU methanol.

Formula 9: Emissions from the production of CCU methanol (incl. CCU credit)

$$PCF_{CCU\ MeOH} = Incorporated\ CCU\ credit + E_{CCU\ MeOH} + E_{unconverted\ CCU\ CO_2}$$

$PCF_{CCU\ MeOH}$	*Product carbon footprint (PCF) of CCU methanol [t CO_2e / t of MeOH]*
$Incorporated\ CCU\ credit$	*Incorporated CCU credit [t CO_2e / t of MeOH] comprises the amount of incorporated CO_2 in the specific MeOH. Furthermore, the total amount of incorporated CCU credit cannot exceed* $(1 - A) * CCU\ credit$.
$E_{CCU\ MeOH}$	*Emissions from the production of the CCU MeOH, including processing and feedstock emissions, without any credit accounting [t CO_2e / t of MeOH]*
$E_{unconverted\ CCU\ CO_2}$	*Considers process emissions of excess CCU CO_2, not converted into a CCU product (and released to the atmosphere) [t CO_2e / t of MeOH]*

Emissions from the production of CCU MeOH ($E_{CCU\ MeOH}$) are to be calculated as follows. The following calculation is referring to formula 7, but, giving more insights on the details of $E_{Feedstock}$ and E_P:

Formula 9: Emissions, related to the production of CCU MeOH

$$E_{CCU\ MeOH} = M_n * EF_n + W_{el} * EF_{el} + W_{th} * EF_{th} + m_{H2} * EF_{H2} + E_{de} + W_t * E_{Wt}$$

$E_{CCU\ MeOH}$	*Emissions, related to the production of CCU MeOH [t CO_2e/t of MeOH]*
M_n	*Quantity of process input (including feedstock, process chemicals, energy carriers, etc.) [t / t of MeOH]*
EF_n	*EF for the production and transport of the process input to the processing unit [t CO_2e / t]*
W_{el}	*Quantity of electricity (electrical work) input [kWh / t of MeOH]*
EF_{el}	*EF for the production and supply of electricity (electrical work) to the processing unit [t CO_2e / kWh]*
W_{th}	*Quantity of process heat (thermal work) input [kWh / t of MeOH]*
EF_{th}	*EF for the production and supply of process heat (thermal work) to the processing unit [t CO_2e / kWh]*
m_{H2}	*Net quantity of H_2 used as feedstock for CCU MeOH production [t / t of MeOH]* *Excess H_2, leaving the process unconverted shall be subtracted from this term. It is preferred to determine the net quantity of H_2 input to produce the CCU MeOH via measurement of H_2 introduction and measurement of H_2 purge leaving the process unconverted. If this is not possible, the net quantity can also be determined via the chemical reactions of the process.*
EF_{H2}	*EF for the production and supply of H_2 to the MeOH process [t CO_2e / t]*
E_{de}	*Direct process emissions [t CO_2e/t of MeOH]* *This term shall consider direct GHG emissions of the MeOH process, excluding emissions of excess CCU CO_2, (see term $E_{unconverted\ CCU\ CO2}$ in Formula 9) not converted into MeOH.*

W_t	*Quantity of waste materials or residues for disposal or waste treatment [t /t of MeOH]*
E_{Wt}	*EF for the treatment of process waste [t CO_2e / t]*

8.3.3.2 Emission factor of H_2 and allocation

Besides CCU CO_2, H_2 is an essential input to produce CCU MeOH. Thus, the PCF calculation shall include the respective environmental burdens associated with the production of the H_2 used for MeOH production.

The EF for the production and supply of the H_2 used to produce CCU MeOH must be calculated based on actual process data. Furthermore, the calculation of the EF for H_2 shall be made available to the auditor in the auditing process. For potential production processes to produce eligible H_2 under this certification approach, see *3.2.2 ISCC CFC certificate*. The EF of H_2 must consider the input of energy sources (e.g., electricity or a gaseous energy carrier) and direct GHG emissions of the H_2 production process as well as emissions from the distribution of the H_2. Since the H_2 for the CCU MeOH production results from a multi-output process, the EF of the H_2 shall be determined based on an energy-based allocation, following the formula below.

Formula 10: Allocation factor for H_2 production/ supply

$$AF_{H_2\,upstream\,emissions} = \frac{M_{H_2} * LHV_{H_2}}{(M_{H_2} * LHV_{H_2}) + (M_{co-product} * LHV_{co-product})}$$

$AF_{H2\,upstream\,emissions}$	*Allocation factor for H_2 production/ supply [-]*
M_{H_2}	*Net quantity of H_2 [kg]*
LHV_{H_2}	*Lower heating value of H_2 [MJ / kg]*
$M_{co-product}$	*Net quantity of co-product [kg]*
$LHV_{co-product}$	*lower heating value co-product [MJ / kg]*

8.3.3.3 Allocation of products from CCU MeOH production

In case the CCU MeOH is produced from a multi-output process, the GHG emissions calculated with the approach described under *Formula 4* shall be allocated between the MP, the CCU MeOH and co-products such as heat or conventional MeOH. A prerequisite for the consideration of heat as a product is that the heat is utilized in other processes. Emissions from downstream processing or transport and distribution emissions of CCU MeOH cannot be added prior to allocation, as those emissions are not related to the co-products. The allocation of GHG emissions to any products that are considered waste or residue is not permitted[20]. Additionally, the allocation of the CCU credit to conventional MeOH as a potential product is not permitted.

Specific rules for the allocation of BPs are defined in *4.1.6 Allocation*.

[20] For the classification of waste and residues, please refer to ISCC 202-5.

8.3.3.4 Calculating a PCF for conventional MeOH production

When assessing integrated production systems, in which CCU MeOH is produced together with conventional MeOH, the defined methodology can also be used to calculate a PCF of the conventional MeOH. Unlike the CCU MeOH, no CCU CO_2 and related CO_2 credits can be applied during the PCF calculation for conventional MeOH. Furthermore, the sources of CO_2 and H_2 might differ from the eligible sources for CCU MeOH defined in this document. In addition, the two PCF approach, as defined *8.1.4.3* in shall be considered to calculate a baseline PCF for the MeOH production without CCU CO_2.

8.3.3.5 Data basis

Chapter *4.2 Data as the basis – LCI* defines the requirements for the data to be collected and used as an input for the PCF calculation of CCU MeOH.

The following data for the calculation of GHG emissions from the MeOH production process must be gathered on-site. All input values must be gathered for the same reference time period (identical start and end date). In the example below the period of 1 year is used.

- Amounts of CO, CO_2 and H_2 introduced into the process (e.g., per t of MeOH per year) as well as their specific source (e.g., syngas process, “recycled” excess H_2)
- The input and output data of the syngas process, including the use of feed, electricity, as well as the process output (e.g., syngas, heat) and process emissions
- Source and amount of electricity used for the operations (e.g., MWh per year)
- Source and amount of process heat used for the operations (e.g., MWh per year)
- Source and amount of CO_2, captured from external processes
- Type and amount of additional process inputs (e.g., t per year)
- Amount of MeOH produced (e.g., t per year)
- Amount of BPs produced (e.g., t excess H_2 per year)
- Amount of process wastes (e.g., t per year). Waste streams might be clustered in case the EF for their treatment processes is the same.
- Amount and composition of flue gas and other direct process emissions, especially in relation to climate relevant emissions (e.g., CO_2, CH_4, N_2O, etc. in t per year). If these emissions cannot be measured directly, they shall be calculated based on the process inputs and outputs.

- Process data for the H_2 production and/ or detailed information about the EF calculation for H_2.

9 Silicon metal produced with renewable energies

9.1 Introduction

Silicon is an important pre-product for many applications in different industrial sectors. Besides its use in the electrical, semi-conductor, photovoltaic and chemical industry, silicon is also used as an alloying element for the steel and aluminum production.

The various fields of application require different qualities, which results in different process treatments of the silicon. However, the first step always is the production of raw silicon in forms of ferrosilicon or silicon metal.

On an industrial level, the production of silicon is usually done with an electric arc furnace (EAF) which reduces quartzes and quartzites (hereinafter referred to as “Quartz/ite”), which are both mainly composed of silica (silicon dioxide (SiO_2)) with carbon as a reducing agent in an energy intense process. Besides silicon metal and silica fume, this process results in different off-gas components.

Depending on the specific process set-up as well as the type of reducing agents (e.g., the use of fossil or biogenic carbon) or electricity sources used, the PCF of the silicon product can vary significantly. Thus, the approach described in this chapter shall provide a basis to calculate, verify and communicate GHG emissions and emission reductions in the production of silicon metal compared to business-as-usual scenarios or a benchmark for the industry average.

This section describes the general approach for the calculation of GHG emissions for silicon metal production under the ISCC CFC module and provides guidelines for the certification of the corresponding PCFs. Specific requirements related to the collection of input data and the verification of the calculation are subject to the subsequent chapters. The PCF of silicon metal is mandatory to be published on the ISCC CFC certificate.

9.2 Scope and normative references

The scope of this chapter is the PCF calculation for Silicon metal within a cradle-to-gate approach. The general approaches for GHG emission calculations of various products will be, to the extent possible, widely harmonized under the ISCC CFC module. The methodology defined in this document follows the general approach defined in ISO 14067:2018, with further specifications to produce silicon metal.

9.3 Methodology for the calculation of PCFs for silicon metal products

The ISCC EU System Document 205 “Greenhouse Gas Emissions” explains the options of stating GHG emissions along the supply chain and provides the methodology, rules and guidelines for calculating and verifying GHG emissions and emission reduction.

This chapter defines specifications in the calculation of the PCF for silicon metal as well as the necessary verification of PCF calculations for silicon metal under ISCC CFC.

The calculation of GHG emissions from the production of silicon metal shall consider the direct emissions of the silicon metal production process, the upstream emissions associated with the production and the supply of process inputs such as electric energy, other process inputs and reducing agents, as well as potential co/by-products of the process (e.g., silica fume). The certification approach for silicon metal under ISCC CFC hence aims for the calculation of a cradle-to-gate PCF for silicon metal considering all emissions happening prior to the gate of the silicon metal selling company, which can be forwarded to the downstream customer.

Figure 16 shows a simplified process flow with the relevant parameters for the calculation.

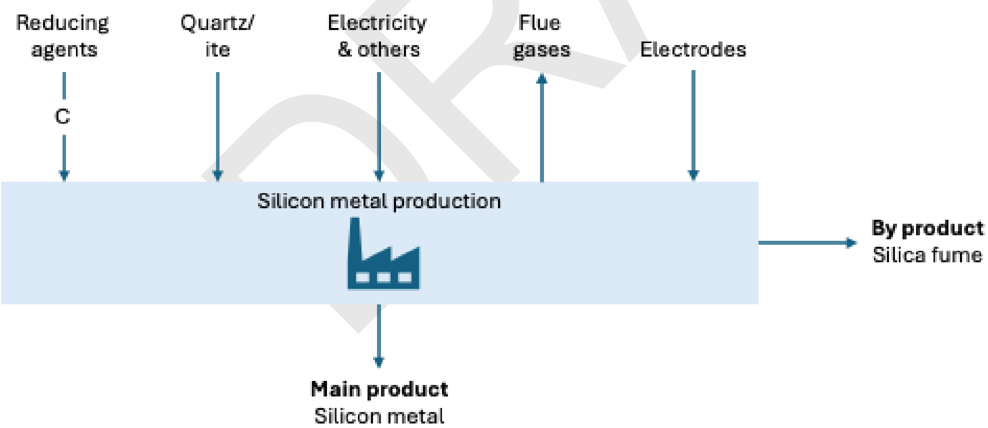

Figure 16: Main parameters for the PCF calculation of silicon metal

Typical set ups for the production of silicon metal[21] consider the use of SiO_2-based raw materials (Quartz/ite) as the material feedstock, different kinds of carbon sources as reducing agents (e.g. coal, wood, charcoal), the input of electric energy for the operation of the EAF, the use of consumable electrodes and potential other process inputs (e.g. limestone, oxygen, nitrogen, fuels).

[21] As for example defined by Schei, Anders & Tuset, Johan & Tveit, Halvard. Production of High Silicon Alloys. Trondheim (1998): TAPIR, ISBN: 8251913179

Thus, the GHG emissions of the silicon metal production shall be calculated as:

Formula 11: Emissions from the production of silicon metal

$$E_{sm} = \left(m_{ra} * EF_{ra} + m_{Quartz/ite} * EF_{Quartz/ite} + W_{el} * EF_{el} + m_n * EF_n + E_{flue\ gas}\right) * A_{sm}$$

E_{sm}	*Emissions from the production of silicon metal [kg CO_2e / t of silicon metal]*
m_{ra}	*Quantity of reducing agent [kg / t of silicon metal]*
EF_{ra}	*EF for the production and transport of the reducing agent to the PU [kg CO_2e / kg]* *The EF shall consider all process steps until the provision of the process input to the silicon metal production unit, including production, storage and transport steps.*
$m_{Quartz/ite}$	*Quantity of Quartz/ite inputs [kg / t of silicon metal]*
$EF_{Quartz/ite}$	*EF for the production and transport of Quartz/ite to the PU [kg CO_2e / kg]* *The EF shall consider all process steps until the provision of the Quartz/ite to the silicon metal production unit, including production, storage and transport steps.*
W_{el}	*Quantity of electricity (electrical work) input [kWh / t of silicon metal]*
EF_{el}	*EF for the production and supply of electricity (electrical work) to the PU [kg CO_2e / kWh]* *The EF shall consider all process steps until the provision of the process input to the silicon metal production unit.*
m_n	*Quantity of additional process input [kg / t of silicon metal]*
EF_n	*EF for the production and transport of the additional process input to the PU [kg CO_2e / kg]* *The EF shall consider all process steps until the provision of the process input to the silicon metal production unit, including production, storage and transport steps.*
$E_{flue\ gas}$	*Direct process emissions [kg CO_2e]* *The climate impact of the flue gas emissions shall be considered according to the characterization factors of the different GHG components. CO_2 emissions from the combustion of biogenic carbon sources (e.g., when sustainably sourced charcoal is being used as a reducing agent) shall be taken to be zero.*
A_{sm}	*Allocation factor for silicon metal [-]. Please see next section.*

9.4 Allocation factors for silicon metal and BPs

Emissions calculated according to the above defined approach shall be allocated between silicon metal and any additional products occurring from the silicon metal production process. The allocation of GHG emissions to any products that are considered a waste is not permitted. (For the classification of waste and residues, please refer to ISCC 202-5.)

The allocation of emissions shall be based on the mass flows of the products. Consequently, the allocation factor AF of the silicon metal, shall be calculated as:

Formula 12: Allocation factor of silicon metal

$$A_{sm} = \frac{m_{sm}}{m_{sm} + m_{co-product}}$$

A_{sm}	*Allocation Factor of silicon metal [-]*
m_{sm}	*Quantity of silicon metal [kg]*
$m_{co-product}$	*Quantity of co-/ by-product [kg]*

9.5 Benchmarking and claiming

Under the ISCC CFC approach for silicon metal, the absolute value of the PCF calculated via the here described methodology (E_{sm}, see *Formula 11*) needs to be published together with the certification. In addition to the absolute PCF value to be given, potential emission reductions can be claimed in comparison to respective benchmarks. Once the benchmark value is selected, the emissions reductions can be calculated as:

Formula 13: Emission reduction of considered silicon metal vs. benchmark

$$Emissions\ reduction = \frac{E_{Benchmark} - E_{sm}}{E_{Benchmark}}$$

$Emissions\ reduction$	*Emission reduction of considered silicon metal compared to benchmark silicon metal [%]*
$E_{Benchmark}$	*Emissions from the production of silicon metal, benchmark value [kg CO_2e / t of silicon metal]*
E_{sm}	*Emissions from the production of silicon metal [kg CO_2e / t of silicon metal]*

For claiming emission reductions, the selected benchmark needs to be clearly referenced. Two possibilities apply for the benchmark value:

Reference global value

In this case, the benchmark value will be a reference value for emissions related to silicon metal production on a global level. ISCC has selected a value from the ecoinvent data base of 10.9 kg CO_2e/ kg-silicon metal. This value is based on the “market for silicon, metallurgical grade, GLO” activity from ecoinvent, version 3.9.1, impact category GWP100 IPCC 2021. The value will be updated by ISCC once more recent data are available. When the calculation of silicon metal emissions according to the here outlined methodological requirements (including identical system boundaries, identical FU/ reference flow) results in lower emissions than a defined threshold of the reference global value, an additional claim on “low-carbon silicon metal production” is possible. For the certified silicon metal PCFs under ISCC CFC this threshold is set to 40% reduction compared to the global reference value to qualify for a low carbon product claim (PCF lower than 10.9 *(1-0.4) = 6.5 kg CO_2e/ kg-silicon metal).

Reference to system user's silicon metal production prior to emission reduction measures

In this case, the benchmark value for the silicon metal production emissions is the emission value calculated for the system user, before a new emission reduction measure was in place. This means the system user shall identify what were the original emissions for silicon metal production on its own production plant. The emissions from prior to the added emission reduction measure shall be calculated following the same methodology as laid out in this document. The systems user's reference production PCF value cannot be older than three years prior to the certification year and the year of comparison need to be stated in the claim. Independent of the achieved emission reduction compared to the system user's reference production this comparison does not qualify for the additional "low carbon silicon metal production" claim. The low carbon product claim is only possible when achieving the threshold of 40% reduction compared to the reference global value (see *Reference global value*).

It shall be highlighted that, while the calculation and claiming of emission reductions is optional, the communication of the calculated absolute PCF value is mandatory under ISCC CFC.

9.6 Data basis

The PCF calculation is based on actual data gathered from the individual (to be) certified company and, if needed, data sourced from databases and literature.

Data gathering during the audit is relevant for the process inputs defined in the PCF calculation in *Formula 11* including e.g. energy consumption, other process inputs and for output data like process emissions, wastes, products and BPs. Relevant parameters, which cannot be measured (e.g., process flue gas emissions) shall be calculated based on the input and output flows of the process and the corresponding chemical conversion.

Actual data measured and gathered at the system user's site must be documented and provided to the auditor for the verification. This can include production reports, production information systems, delivery notes, weighbridge protocols, contracts, invoices and others. The calculation period should cover a full twelve-month period.

It must be as up to date as possible. As an alternative, it must cover the previous calendar or financial year. In cases of exceptional maintenance measures and unstable production conditions a shorter period (for inputs and respective outputs) may be considered if it better reflects the relevant timeframe. The respective period for data gathering and thus for the calculation of GHG emissions must be transparently displayed in the calculation.

9.6.1 On-site data gathering

The following data for the calculation of GHG emissions from the silicon metal production process must be gathered on-site. They will form the basis for the calculation of GHG emissions. All input values must be gathered for the same reference time period. In the example below the time period of 1 year is used:

- Type and amount of reducing agent (e.g., t coal or charcoal per year),
- Amount of Quartz/ite (e.g., t Quartz/ite per year),
- Source and amount of electricity used for the operations (e.g., MWh per year),
- Type and amount of additional process inputs (e.g., t per year),
- Amount of silicon metal produced (e.g., t per year),
- Amount of BPs produced (e.g., t silica fume per year),
- Amount of process waste (e.g., t per year); waste streams might be clustered in case the EF for their treatment processes is the same,
- Amount and composition of flue gas and other direct process emissions, especially in relation to climate relevant emissions (e.g., CO_2, CH4, N_2O, etc. in t per year): If these emissions are not measured directly, they shall be calculated based on the process inputs, outputs and corresponding chemical conversion (e.g., the amount of CO_2 based on the amounts of used carbon reducing agent inputs and the assumptions of a chemical conversion to CO_2). If the amount of a climate active flue gas cannot be measured, the company must show during the audit that these flue gases are only produced in neglectable amounts (e.g. by literature process description of the applied process).

9.6.2 Published data

The following types of data for the calculation of GHG emissions can be gathered from reviewed databases and literature as well as from official statistics:

- EFs for the production and transport of the used reducing agents,
- EFs for the production and transport of the Quartz/ite used in the process,
- EFs for the production and supply of additional process inputs,
- EFs for electricity and other energy sources in kg CO2e per unit of energy used,
- EFs for the treatment of wastes and residues.

9.6.3 Requirements for the EF of used electricity

If electricity is sourced from the grid, the EF for electricity from the regional electricity mix shall be used.

If electricity from renewable energies or other sources is directly consumed, an adapted EF for the type of renewable electricity may be used. This is possible under two conditions: a) if that plant is not connected to the electricity grid; or b) there is a direct connection between the PU and the individual electricity production plant, being possible to validate the amount of electricity used with a suitable meter. (Adapted EFs by the use of Power Purchase Agreements (PPAs) are currently being evaluated by ISCC and may be added in revisions of this document.)

9.7 Specific verification guidance for PCF calculation and used EFs

Existing publications on the GHG emission of silicon production indicate important drivers and influencing factors for the overall PCF of silicon. These can include:

- The source and GHG intensity of the electricity used in the silicon production process
- The amount and specific composition of the flue gas emissions from the silicon production process
- The source of the reducing agent (carbon) and the emissions associated with its production

Verification of PCF calculations for silicon under ISCC CFC should recognize the importance of these parameters and verify individual calculations or EFs for these elements.

In case biogenic carbon (e.g., from charcoal or wood chips) is used as a reducing agent, the following aspects need to be verified for the choice of an appropriate EF:

- The EF for the reducing agent shall include the complete supply chain from the cultivation and sourcing of the biogenic feedstock, the transport of the feedstock, to the processing and final transport to the silicon production. Respective PCF calculations and EFs of the used charcoal shall be checked regarding the completeness of system boundaries, covering the complete value chain from the production and supply of the biogenic feedstock, the conversion to a reducing agend as well as the distribution process to the silicon metal production.
- Direct emissions from the processing of the biogenic feedstock (e.g., in a pyrolysis process to produce charcoal as reducing agent) have to be considered, following the methodology defined in the ISCC 205 GHG emission document:

  - Evidence of appropriate measures for the recording of emissions from the processing of the biogenic feedstock shall be provided when requested.
  - Records of emissions from the processing of the biogenic feedstock shall be provided when requested.
  - Records for energy consumption of the processing of the biogenic feedstock shall be provided when requested.
  - The verification of those primary data from the suppliers of the reducing agent processing biogenic feedstock may need a direct communication between the auditor and the supplier. The system user is to facilitate that direct communication. If requested, the auditor may also decide to verify specific parts of the EF calculation of the reducing agent on-site at the supplier (e.g. the handling of pyrolysis gases from pyrolysis process).
  - The calculation of emissions of co-products produced during the production of reducing agents from biogenic feedstock need to follow the methodology defined in the ISCC 205 GHG emission document (see defined allocation procedures, e.g., no system expansion).
- It shall be verified that the biogenic feedstock is sourced from sustainably managed areas and forests. Biomass and biofuels used as a process input (e.g., as a reducing agent) produced from forest biomass shall meet the following land-use, land-use change and forestry (LULUCF) criteria:
  - The country or region of origin of the forest biomass:
    - Is a Party to the Paris Agreement;
    - Has submitted a nationally determined contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC), covering emissions and removals from agriculture, forestry and land use which ensures that changes in carbon stock associated with biomass harvest are accounted towards the country's commitment to reduce or limit GHG emissions as specified in the NDC; or
    - Has national or sub-national laws in place, in accordance with Article 5 of the Paris Agreement, applicable in the area of harvest, to conserve and enhance carbon stocks and sinks, and providing evidence that reported LULUCF-sector emissions do not exceed removals.

- Where evidence regarding these points is not available, verification of the sustainable sourcing of biomass can be done in two alternative approaches:
  - Sourcing biomass from an ISCC certified forest/ forest management unit
  - Certification against the requirements of a certification scheme recognized by ISCC, or of compliance with appropriate ISCC recognized local regulation (EU forestry strategy22)
- Records of the shipment of materials from forest to PUs, and from PUs to secondary PUs (etc.) shall be provided when requested.

[22] Forests: in: Environment. *https://environment.ec.europa.eu/topics/forests_en*