

Chain of custody models and definitions

A reference document for
sustainability system stakeholders

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Introduction

Chain of custody (CoC) is one of the key system elements of most sustainability standards and voluntary certification schemes (referred to throughout this document as ‘sustainability systems’). By defining a set of requirements that control the movement, handling and processing of certified materials and volumes within and between certified companies (usually defined within a chain of custody standard), CoC enables the transfer of claims and communications about materials, products, processes and services covered by a sustainability system. An assurance system verifies whether certified companies have met relevant CoC requirements, underpinning trust in the claims made about tracked materials and attributes.

There are a range of CoC models used by sustainability systems to track materials and attributes through certified supply chains, allowing for different types of claims depending on material and market specific requirements, needs and constraints. Each industry or sector need is different and the requirements of CoC standards and assurance systems will vary as a result. When discussing how chain of custody is used by sustainability systems, it is important to have a consistent shared reference language, which is the goal of this document.

This document is intended to:

- Provide a reference for discussions about CoC and sustainability systems using shared language
- Present definitions and descriptions of the different CoC models used in sustainability systems
- Identify conditions under which each CoC model is appropriate for different supply chains
- Identify how CoC models can support the intended outcomes and impacts of sustainability systems
- Support the link between CoC and appropriate claims, which is further developed in the ISEAL Claims Good Practice Guide.

This document is **not intended to:**

- Serve as a definitive guide for CoC in contexts outside of sustainability systems
- Indicate that one (or more) CoC model is preferable to another
- Capture or describe the benefits and drawbacks for each CoC model, beyond identifying the conditions under which each CoC model is appropriate
- Suggest that the models and claims noted here reflect best practice or good practice – they are simply capturing common practice.

The document is split into 2 sections:

Section 1: covers the theory behind chain of custody, including key concepts such as the major differences between CoC model types, CoC system boundaries, and attribute transfer methods.

Section 2: provides descriptions of identity preservation, segregation, controlled blending, mass balance, controlled mass balance and book and claim models.

Terms and definitions

General terms

Chain of custody (CoC): a means by which inputs, outputs, and associated attributes are transferred, monitored and controlled as they move forward through each step in the supply chain (adapted from ISO 22095:2020)

Traceability: the ability to track and verify the history and location of a material's movement through defined stages of production, processing and distribution (adapted from ISO 22095:2020)

Specified characteristics: A set of production, material and product characteristics that the CoC is designed to maintain (ISO 22095:2020)

Input: In the context of CoC, material or product that enters an organisation or part of an organisation

Output: In the context of CoC, material or product that leaves an organisation or part of an organisation

Co-products: Outputs of manufacturing processes which hold significant economic value, and are deliberately produced

By-products: Incidental outputs of manufacturing processes which are usually lower in value and desirability, compared to co-products

Attribution: the process of assigning specified characteristics to outputs within a CoC system boundary

Non-proportional attribution: the assignment of specified characteristics to outputs in a way that does not mirror the physical blending of materials

Proportional attribution: the assignment of specified characteristics to outputs that mirrors the physical blending of materials with a manufacturing process

Claim: In the context of CoC, the declared information regarding the specified characteristics of a material or product (adapted from ISO 22095:2020)

CoC system boundaries

System boundary: the parameters in which the transfer of inputs, outputs and specified characteristics are controlled. These are defined by the following factors:

Transfer boundary: The spatial boundaries in which the transfer of specified characteristics between inputs and outputs is controlled and tracked

Temporal restrictions: Requirements that specify different time periods for different actions within the CoC system

Product groups: groups of input and output products that are treated as equivalent for the purpose of tracking, controlling and reconciling volumes within the CoC system boundaries

Volume reconciliation: the balancing of input and output of materials with specified characteristics, such that the volume of output materials with specified characteristics does not exceed the volume of input materials, accounting for conversion factors and loss

Volume reconciliation period: time frame when inputs and outputs with specified characteristics are balanced within the temporal boundaries of the system

Conversion factor: the ratio which is used to determine the quantity of output(s) that can be obtained from the quantity of input(s) used in the manufacturing or production process, considering losses and wastage

CoC models

Chain of custody model: the approach taken to control inputs and outputs, and transfer specified characteristics within the CoC system (adapted from ISO 22095:2020)

Identity preservation: A CoC model in which certified materials from a single source are kept physically separate from non-certified materials and materials from different sources, from initial input to final output (adapted from ISO 22095:2020)

Segregation: A CoC model in which certified materials are kept physically separate from non-certified materials from initial input to the final output (adapted from ISO 22095:2020)

Controlled blending: A CoC model in which certified input materials are mixed according to certain criteria with non-certified materials or product, resulting in a known proportion of certified materials in the final output (adapted from ISO 22095:2020)

Mass balance: A CoC model in which certified input materials are mixed according to defined criteria with non-certified materials, and where there is no guarantee of physical

presence of specified characteristics in a material (adapted from ISO 22095:2020)

Controlled mass balance: A variation of mass balance, where all input material entering the system boundary has specific attributes – most commonly that all the material, whether certified or not, is compliant with a set of minimum specified legal or sustainability requirements

Book and claim: A model in which the transfer of certified volumes are decoupled from the physical flow of material or product through the supply chain (adapted from ISO 22095:2020)

Diagrams key

The following key explains the symbols, colours and icons used throughout this guidance to represent chain of custody (CoC) concepts and processes. Refer to this key when interpreting diagrams related to specified characteristics, claims, and product groups.





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Section 1

Understanding Chain of Custody

1.1 What is chain of custody, and how is it different to traceability?

The concept of chain of custody (CoC) means different things in different contexts, and continues to evolve. This has led to some confusion about what CoC means in the world of supply chains, and how it differs from traceability. This sub-section seeks to clarify this confusion, and track how the concept of CoC in supply chains has been shaped over time.

In legal and forensic settings (where the concept of CoC comes from), the purpose of CoC is to document where evidence originated from, who has handled evidence, and what has happened to that evidence as it moves from crime scene to court room. Establishing a CoC in a legal context is critical as it allows evidence presented at court to be linked to a suspected crime. CoC establishes the integrity and authenticity of evidence – when CoC is broken, evidence is easily contested, and can be deemed inadmissible.

The concept has since been taken up in supply chains, as a means of demonstrating a link between material production to end products, and substantiating business-to-business (B2B) and business-to-consumer (B2C) claims. However, there are fundamental differences in the nature of these legal and supply chain contexts. Physical evidence from a crime scene is unique, comes from a single source, and is kept separate and identifiable from evidence associated with the same and other crimes. In supply chains (and particularly in commodity supply chains like those of agrifood, textiles, energy and metals), material may be treated as fungible, originate from a number of sources, and be mixed, aggregated and transformed multiple times as it moves through networks of suppliers. There may also be a range of different attributes and characteristics

associated with material production and manufacturing that stakeholders wish to track through CoC systems.

As a result, the concept of CoC in supply chains has evolved to accommodate this complexity and diversity - placing far greater emphasis on how material inputs, outputs and associated attributes (e.g. whether a volume is certified) are transferred, monitored and controlled as they move forward through each step of the supply chain. Much less emphasis is placed on tracking exactly who was involved in the production and manufacturing of a given material or product (in complex commodity supply chains, this could be tens of thousands of companies). Documentation remains critical, but its function has changed – now it is used to evidence the transfer of volumes of materials between buyer and seller, and how these materials are controlled within an entity's operations. This is usually how chain of custody works in the context of sustainability systems, and is the context described in this guidance document.

CHAIN OF CUSTODY

A means by which inputs, outputs, and associated attributes are transferred, monitored and controlled as they move forward through each step in the supply chain (adapted from ISO 22095:2020)

TRACEABILITY

The ability to track and verify the history and location of a material's movement through defined stages of production, processing and distribution (adapted from ISO 22095:2020)

In contrast, traceability refers to the ability to track and verify the history and location of a material's movement through defined stages of production, processing and distribution. It is closer in intent to the legal notion of CoC (fulfilling the need to know who handled materials, and what happened to said materials), yet for companies at the end of the supply chain, it is often an exercise in looking backwards – piecing together information relating to material components of a product.

Where traceability information is missing, or materials cannot be linked to exact production origin (as is often the case, due to the inherent complexity of global supply chains), the traceability of that product ends. For this reason, it is common for end companies to have traceability of materials back to a certain point – whether to a point in the supply chain (e.g. a specific manufacturing tier, or potentially to the first point of processing), or to a defined spatial area (e.g. landscape, sourcing region, country).

Regulators interested in sustainability, security and supply chain resilience are increasingly mandating traceability in certain global supply chains. This is driving uptake and

adoption of digital traceability systems which can enable the tracking of material, product information and changes in custody / ownership in near real time as material supply moves forward through the supply chain (closer to the legal concept of CoC). However, adoption rates are uneven, with technology favouring more digitised supply chains at the expense of SMEs and small-scale producers. There is a risk that if digital traceability becomes a requirement of trade, some supply regions will be excluded.

Sustainability systems are increasingly investing in their own digital traceability tools and systems to better support the companies they work with to meet their regulatory obligations, while supporting capacity building and inclusion in the supply chains they work in.

In parallel to the scaling of digital traceability systems to support regulatory compliance, new applications for CoC continue to emerge. A use case rapidly gaining traction is to enable target setting, accounting and reporting in corporate climate and nature frameworks, like the Greenhouse Gas Protocol's Land Sector Removals Standard, and the Science-Based Target Initiative's Corporate Net Zero Standard. In these frameworks, chain of custody is used to determine a relationship between activities and the value chains of reporting companies, and facilitate the appropriate attribution of quantitative metrics (e.g. emissions data) associated with production, manufacturing and transportation. However, the context is different again (e.g. the tracking of quantitative attributes that accumulate as materials move through the supply chain, with relationships inferred at entity, rather than material level), and the concept of CoC will need to further evolve to accommodate this additional complexity.



1.2 Functions of chain of custody in sustainability systems

CoC system elements usually include:



Normative requirements
(a CoC Standard),



A monitoring and verification
mechanism



A means of identifying and controlling
sites and entities participating in the CoC



A centralised volume tracking and
reconciliation system

Depending on the approach taken, CoC systems have some or all of the following functions:

- Track and control volumes of certified materials and specified characteristics as they flow through the supply chain
- Demonstrate a custodial sequence for materials along the supply chain
- Identify the raw material origins of a final product or product component
- Protect and monitor the integrity of claims
- Capture origin, risk and sourcing information for material entering the supply chain
- Link sustainability practices, performance or outcomes at a certain stage in the supply chain with a product claim at the end of the chain
- Ensure that entities participating in the CoC meet minimum integrity requirements
- Set minimum performance and verification requirements for non-certified materials purchased by supply chain entities

These functions can allow sustainability systems to:

- Ensure that volumes of certified material sold do not exceed volumes of certified material produced or purchased by a supply chain actor
- Generate demand for certified materials in complex supply chains, enabling the transformation of sectors towards more sustainable production
- Connect producers with sourcing companies and consumers, often with the ambition to open up markets for sustainable producers and contribute to improved producer livelihoods
- Enable incentives, premiums and price differentials to be transferred through the supply chain
- Improve transparency in the supply chain
- Support compliance with voluntary corporate commitments and mandatory regulations that include specific traceability requirements, in the form of supply chain management and other due diligence obligations
- Allow access to reliable data on sustainability metrics



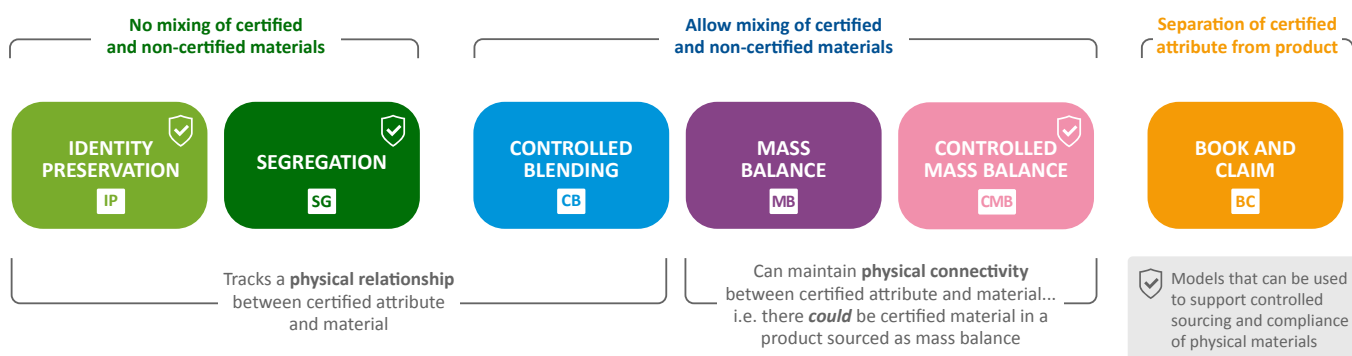
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1.3 Making sense of the CoC model landscape

There are a range of different CoC models that determine how materials are tracked, controlled and monitored within supply chains, and it can be confusing to differentiate between

them. This section identifies three ways these models can be categorised and differentiated between. Note that Section 2 of this guidance provides detail on individual CoC models.

Figure 1 – Applying different categories to understand the CoC landscape



1.3.1 Relationships between material content and specified characteristics

At the most basic level, CoC models track administrative and physical relationships between material content and specified characteristics entering and leaving the CoC system boundary. In sustainability systems, the most common attribute being tracked through CoC is certified volumes.

An **administrative relationship** means that specified characteristics correspond to a certified unit of production (e.g. 10 MT of soybeans produced by a certified farm), and are tracked through an administrative document flow. All CoC approaches that control and reconcile volumes of attributes throughout the supply chain using documentation and records maintain an administrative relationship.

A **physical relationship** means that specified characteristics are physically present in the material. Models that provide this physical relationship are Identity Preservation, Segregation and Controlled Blending.

With some models, while this physical relationship may be lost, the CoC system still tracks a connection between the material and its specified characteristics. Although these characteristics might be physically present in the material, the CoC model does not guarantee this. Instead, administrative documents (like purchase and sales records) are used to transfer the specified characteristics between organisations in the supply chain. Throughout this guidance, this connection is referred to as **physical connectivity**. Models that provide physical connectivity are variants of Mass Balance (as described in sub-sections 2.4). It should be noted that physical connectivity in mass balance CoC systems is not a given.

DEFINING MINIMUM LEVELS OF PHYSICAL CONNECTIVITY IN A MASS BALANCE CoC SYSTEM

The likelihood that specified characteristics are physically present in a material will vary across mass balance CoC systems, depending on the nature of the supply chain, and how the mass balance system is designed and implemented (factors described in sub-sections 1.4 - 1.6).

For some stakeholders and use cases, it is important that the likelihood of physical presence is high and quantifiable. For others, there just needs to be a possibility of physical presence. For some, all that matters is that there is an administrative paper trail, and

they are not interested in the certainty that physical presence is indeed possible. As the concept of CoC, and in particular mass balance, is applied in new contexts (e.g. in corporate climate and nature accounting and reporting frameworks), it will be important to align on how strong a link there needs to be between activities in the value chain and reporting companies.

The concepts outlined in this guidance can support this consensus building for both certified and non-certified supply chains, though it is likely that each sector or commodity will have its own thresholds.

With some models, such as Book and Claim, there is **no physical relationship** between the material and specified characteristics. This is because specified characteristics are:

- a) dissociated from the material content, and traded separate to the physical flow of material, or
- b) lack any potential physical connectivity with material content.

1.3.2 Control of material with specified characteristics

Another way of categorising different CoC models is based on their approach to controlling material with specified characteristics.

Segregated: requires the separation and identification of materials with specified characteristics from initial input to final output within the CoC system. Models that require segregation are Identity Preservation and Segregation. The different methods of achieving segregation are outlined in sub-section 1.7.

Mixed: Allows for the mixing and / or substitution of materials with specified characteristics with materials without specified characteristics. Models that allow mixing are Controlled Blending. Models that allow mixing and / or substitution are variants of Mass Balance.

Decoupled: Allows for the dissociation of specified characteristics from material. The material is then traded without specified characteristics. The model that allows decoupling is Book and Claim.

1.3.3 Control of material compliance

Finally, CoC models can be categorised by their approach to controlling the compliance of material inputs being tracked through the CoC system, where compliance is defined as a set of minimum legal or sustainability requirements.

When production standards are aligned to these minimum requirements, Identity Preservation and Segregation can support compliance at the level of product volumes, and offer controlled sourcing solutions.

When minimum legal or sustainability requirements are mandated for non-certified materials, variations of mass balance (referred to in this guidance as Controlled Mass Balance – see 2.5 for more information) may fulfil a similar function, and provide supply chain organisations models that support controlled sourcing for both certified and non-certified supply.

Without controls on non-certified volumes, neither controlled blending nor mass balance alone support compliance at the level of product volumes.

It is important to note that within sustainability systems, a product may begin its journey through the supply chain under one CoC model, and transfer to another as it is traded, aggregated and transformed. This can only go in one direction – from more to less stringent CoC models. Materials sourced as segregated may be mixed during manufacturing process. Equally, certified materials may be sold on as non-certified, with an equivalent volume of materials traded as mass balance.

Materials can only transfer from:

- Physical relationship to physical connectivity to no physical relationship
- Segregation to mixed to decoupled
- More granular (e.g. single farm) to less granular (e.g. sourcing region) levels of identity preservation.

It is not possible to ‘upgrade’ a claim (e.g. from mass balance to segregated).

Figure 2 – Example showing how certified coffee can be downgraded from identity preservation to segregation

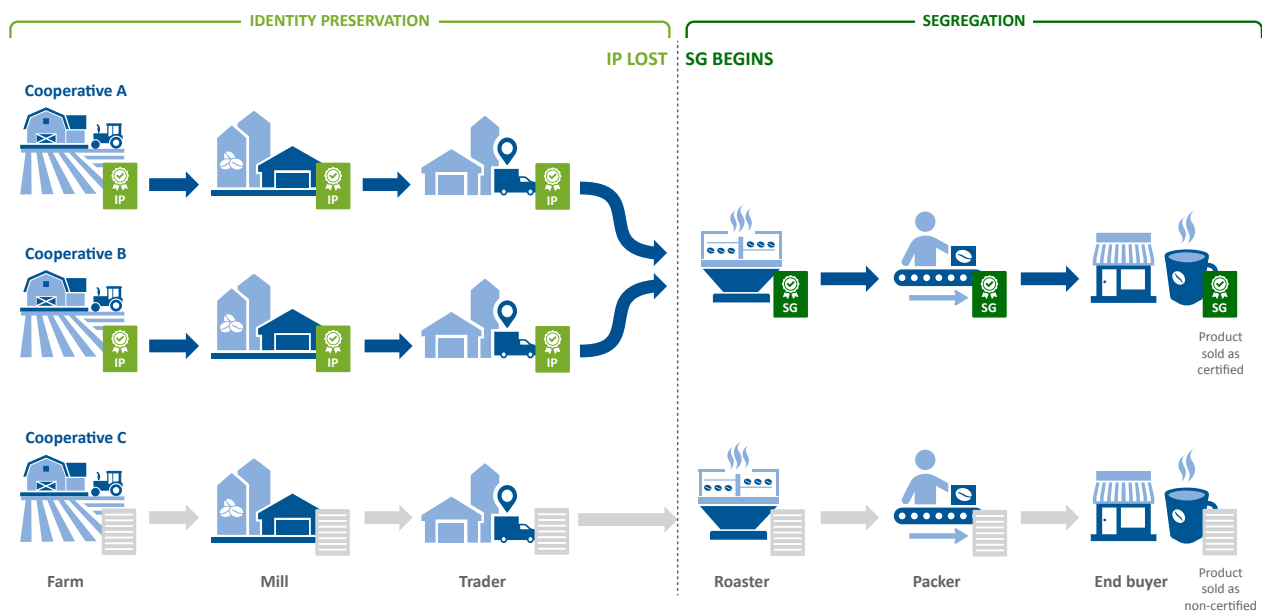
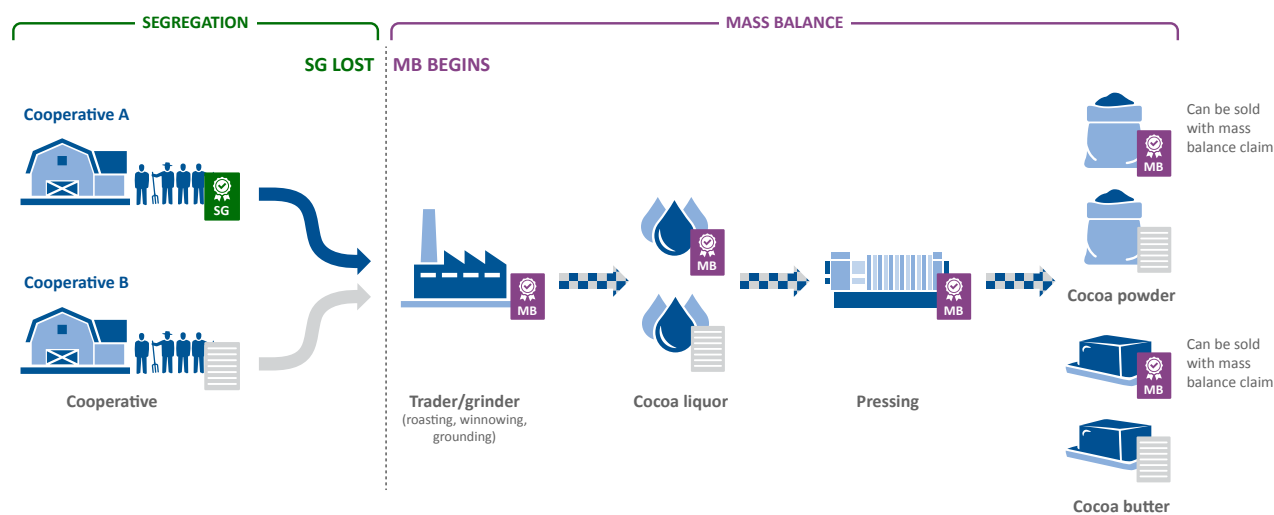


Figure 3 – Example showing how certified cocoa can be downgraded from segregation to mass balance



1.4 Tracking volumes within CoC systems

CoC systems are designed to maintain and track specified characteristics of materials as they move from the point of origin through the supply chain. A data point of critical importance in the context of sustainability systems is the volume of certified materials / products being tracked through the system. Factors that will determine the accuracy of volumes (at an individual and aggregate level) include:

1.4.1 Volume reconciliation and controls

For sustainability systems, volume reconciliation and controls are required throughout the supply chain – including at material production. Systems must be in place to monitor and verify the volume of material with specified characteristics being produced (yield), and the volumes sold into the supply chain with specified characteristics. Depending on the risk of fraud, additional controls may be needed to mitigate substitution and volume inflation at the point of production.

1.4.2 Approach to conversion factors

When material is processed or manufactured, it is common for there to be some loss. CoC systems must account for this when considering whether volumes are balanced. Conversion factors can be calculated using:



Actual wastage, based on volumes of input and output associated with a manufacturing process



Supplier declared averages



Standardised data (e.g. average wastage associated with a manufacturing process and / or material)

A conversion factor of 1 means that there is no loss associated with a manufacturing process.

For volumes to be adequately reconciled, CoC systems need to have mechanisms in place to control for volume inflation and double counting of specified characteristics across co-products and by-products.

ACCOUNTING FOR VARIANCE IN VOLUMES

CoC systems must include some tolerance to variance in recorded and reconciled volumes of materials and products. For some materials, the recorded weight (as documented on sales / transport records) may differ to the weight or volume of material received by a manufacturing facility. This may be because of differences in the calibration and accuracy of measurement tools like weighbridges, or because the actual weight of product has changed during transportation or storage (e.g. increased moisture content in cargo shipped by sea).



1.5 Chain of Custody system boundaries

This sub-section describes the main parameters in which inputs, outputs and specified characteristics are transferred, monitored and controlled in CoC systems: transfer boundaries, temporal restrictions and product groups.

When these boundaries are inconsistently applied by entities in the supply chain, it undermines the integrity and credibility of the CoC system. It can also break the physical relationship between material and characteristics in physical CoC models, and the physical connectivity of mass balance models.

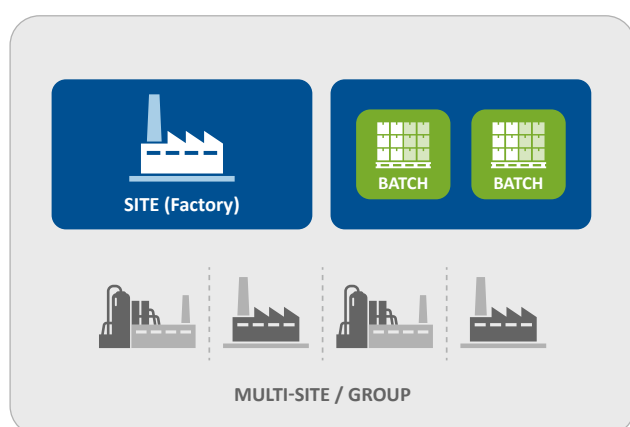
1.5.1 Transfer boundaries

The transfer boundary of a CoC system defines the spatial boundaries in which the transfer of specified characteristics between inputs and outputs are controlled and tracked. Supply chain dynamics and manufacturing contexts vary significantly across materials and sectors – in some, it is possible to track the flow of materials and specified characteristics at a very granular level. In others, the complexity of inventory management, processing and transportation require a less granular approach to enable effective transfer.

Broadly speaking, CoC systems can have the following transfer boundaries:

- Batch (in some industries, they may refer to process),
- Site (in some systems, this may be referred to as facility),
- Multi-site (where all sites are owned by one legal entity)
- Group (where sites are owned by multiple legal entities)

Figure 4 – The relationship between different CoC transfer boundaries



These transfer boundaries are significantly different, and the ability to follow the physical flow of material (and as such the physical connectivity between specified characteristics and materials in mass balance systems) diminishes as the resolution of the transfer boundary increases.



Means that the control and transfer of materials and specified characteristics happens at batch-level, within the same manufacturing process. Batch-level CoC system boundaries are suitable when manufacturing facilities have the systems in place to track inventory and manufacturing at this level of granularity, and where the nature of manufacturing results in the production of distinct batches of output. E.g. a shipment of coffee beans, from a specific cooperative.



Means that the control and transfer of specified characteristics between inputs to outputs is applied to materials at a site within a single geographically distinct location, such as a manufacturing site or storage facility.

Site-level CoC system boundaries are suitable when inventory management and manufacturing processes are more complex, and where manufacturing lines are continuous (meaning there is no 'batch' to track). E.g. the continuous electrolytic reduction of alumina during the aluminium production process. A site can encompass multiple processes, under the control of a common management system.



Means that the control and transfer of specified characteristics between inputs and outputs is applied at a company group level, such as when a company operates or owns multiple manufacturing facilities. This model is suitable when the flow of physical materials entering and leaving manufacturing facilities are constrained, such as when they rely on physical infrastructure, or they are geographically dispersed. It is also suitable in the context of commodity trading, when traders may store materials in multiple warehouses across a given region or geography.



CoC boundaries operate similarly to multi-site boundaries, but can include sites owned by multiple legal entities. These models may be suitable particularly at the start of the supply chain, in the context of group certification of smallholders and SMEs, or where sites are owned by multiple legal entities, such as in joint ventures. The CoC system is administered by a single central office.

PLACING RESTRICTIONS ON TRANSFER BOUNDARIES

It is common practice to place restrictions on multi-site and group-level transfer boundaries, to safeguard the physical connectivity of mass balance CoC systems. Safeguards can include:

- geographical restrictions, such as limiting transfer to sites within the same sourcing region and country,
- requiring all participating sites to be involved in similar production activities, meaning use of the same inputs, outputs, and transformation processes,
- minimum sourcing requirements for all sites operating within the transfer boundary
- requiring all participating sites to be physically connected to the sourcing origin of tracked specified characteristics
- requiring site-to-site transfer of characteristics within the transfer boundaries, either with or without physical transport

1.5.2 Temporal restrictions

Many CoC standards include requirements that specify different time periods for different actions. They may also require materials and attributes to be tracked separately by year of production (like vintages of wine). These temporal restrictions further limit how materials and associated attributes can be transferred, monitored and controlled through the supply chain.

For CoC models that track physical relationships between material and specified characteristics, the transfer of attributes between materials and market participants happens in real time - input materials with specified characteristics are received prior to the sale of corresponding output materials.

In some mass balance systems, organisations can sell output material with associated characteristics, prior to receiving corresponding input material. This is synonymous

to an overdraft facility in banking. Not all mass balance CoC approaches allow this – some require volumes and corresponding attributes to flow in real time.

When such overdraft facilities are allowed in mass balance systems, a volume reconciliation period and process is implemented, which defines the timeframe in which the input and output of materials with specified characteristics must be balanced, and how this must be recorded and evidenced (see figure 5 for an example of a 3-month volume reconciliation period).

Some mass balance CoC models set time periods that are used to determine an average percentage of specified characteristics that can be attributed to output materials (described further in sub-section 2.4). This approach to attribution is referred to as the rolling average percentage method. The time period is sometimes referred to as a 'claim period' (ISO 13662:2025).

HOW DO TEMPORAL RESTRICTIONS AFFECT PHYSICAL CONNECTIVITY IN MASS BALANCE SYSTEMS?

Generally speaking, the larger the volume reconciliation period in a mass balance system, the weaker the physical connectivity between specified characteristics and material. However, too strict a reconciliation period may undermine the effectiveness of the mass balance system. Reconciliation periods should be as short as feasible.

Some sustainability systems require mass balance volumes to be transferred within a certain time period, after which they expire and can no longer be transferred. Requirements like this push certified volumes through the supply chain, increasing the likelihood of physical presence of specified characteristics in claimed materials.

Figure 5 – Representation of a 3-month volume reconciliation period (assuming a conversion factor of 1)

JANUARY		FEBRUARY		MARCH	
Purchase	0 MT	Purchase	30 MT	Purchase	20 MT
Sales	40 MT	Sales	10 MT	Sales	0 MT
Mass balance account	– 40 MT	Mass balance account	– 20 MT	Mass balance account	0 MT

In the example above, an organisation sells 40MT of claimed material in January (month 1). Over the next two months, the organisation sells a further 10 MT of material, while purchasing 50 MT. By doing so, the organisation has reconciled, or ‘balanced out’ the volumes being tracked through the CoC system.

1.5.3 Product groups

In most CoC systems, whether physical or mass balance, supply chain entities are required to establish product groups – groups of input and output products that are treated as equivalent for the purpose of tracking, controlling and reconciling volumes and attributes. Products within a group belong to the same product type and will likely have the same conversion factor depending on how they are calculated (more information on tracking volumes and conversion factors can be found in sub-section 1.4.2).

When a manufacturing process generates multiple co-products (outputs which hold significant economic value and are deliberately produced), each co-product is usually treated as a separate product group. These differ from by-products, which are incidental, and usually lower in value and desirability.

There may be circumstances, such as in chemical processing, where all co-products of a given manufacturing process are treated as a single product group for accounting purposes. This should be clearly communicated to system users and justified.

Specified characteristics can usually only be transferred from one product group to another when there is a direct input – output relationship between them.

Product groups can be determined:

- By the sustainability system, either standardised formally within normative documentation, or embedded within the data standards of digital CoC systems. Examples include the FSC Product Classification Standard ([FSC-STD-40-004a](#)), and Textile Exchange’s Materials, Processes and Products Classification ([ASR-13-V1.1](#)).
- Using externally defined nomenclature, such as Harmonised System (HS) classification approach.
- By the supply chain entity, based on the inputs they source, and outputs they produce

In some sustainability systems, further ‘equivalency’ restrictions may be introduced. These include limiting attribute transfer to materials of the same country of origin, quality, price, or other technical parameters.

Generally speaking, the more granular the product groups and other equivalency restrictions used, the greater the level of physical connectivity maintained by mass balance CoC models. However, more product groups also makes implementing the CoC system more complex for supply chain organisations.



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1.6 Attribute transfer in mixed CoC models

In CoC systems, attribution refers to how specified characteristics, e.g. certification status, are assigned to outputs within the system boundary. In segregated CoC systems, specified characteristics are retained as material moves through the supply chain. In mixed CoC models, there are different ways of assigning characteristics from input to output materials. This approach to attribution determines the relationship between the characteristics and the material – whether it's purely administrative, maintains physical connectivity, or maintains a physical relationship.

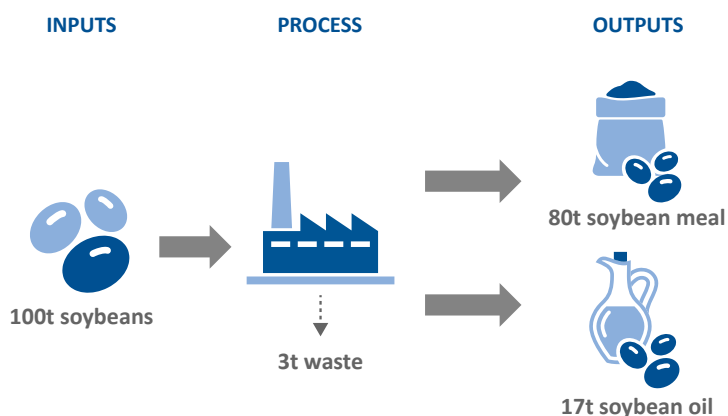
Two main factors influence this relationship:

1. How specified characteristics are **distributed** between product groups, and
2. How specified characteristics are **attributed** to units of output within a product group

1.6.1 Distribution between product groups

As noted in sub-section 1.5.3, manufacturing processes can produce several distinct co-products. Each co-product is usually treated as its own product group for CoC accounting purposes. The conversion factor of the process determines how much of each co-product is produced.

Figure 6 – Example of soymeal / oil manufacturing process, and related conversion factors



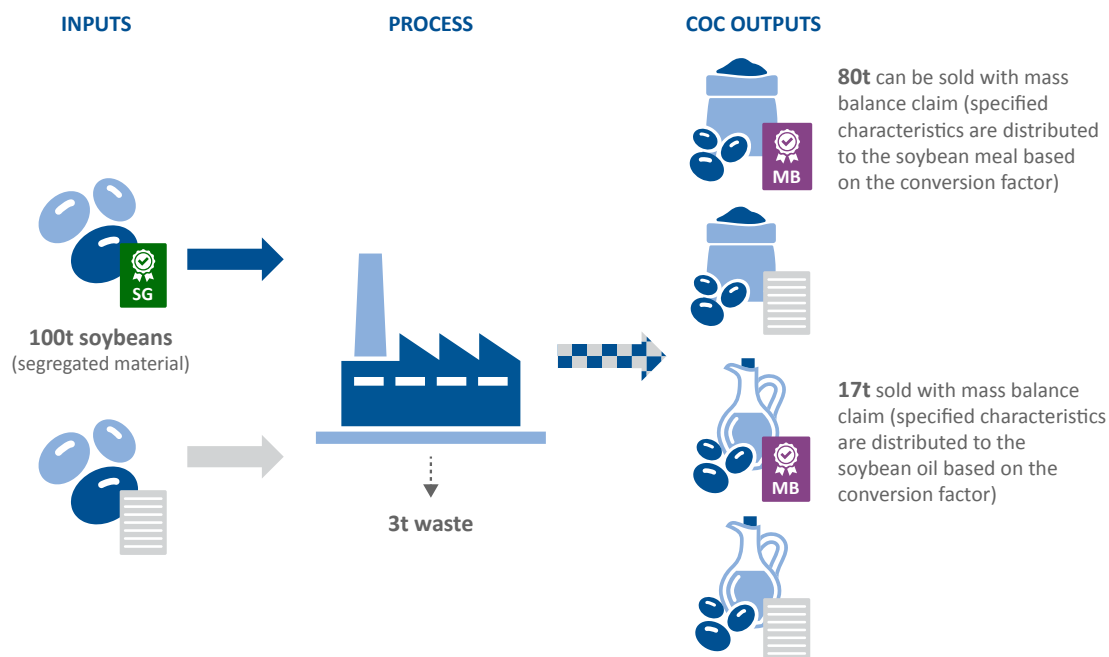
Under the controlled blending CoC model, specified characteristics are distributed proportionately between product groups, following the percentage of certified material entering the manufacturing process, and the related conversion factor.

Under the mass balance CoC model, specified characteristics are distributed among product-groups based on the same conversion factors.



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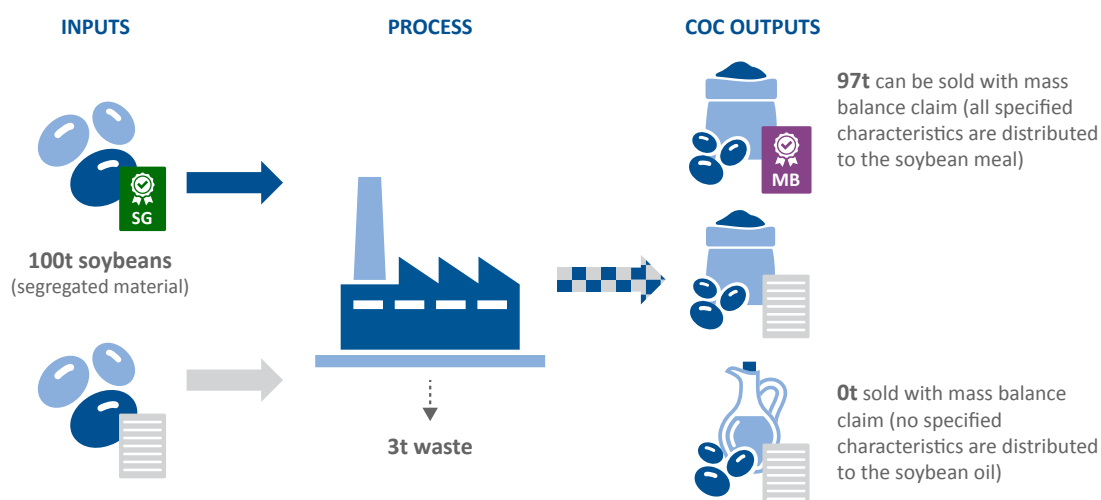
Figure 7 – Example of attribute distribution following conversion factors



If a mass balance system allows specified characteristics to be transferred between product groups not following the conversion factors (non-proportional distribution), it can break the physical link between inputs and outputs and can distort the volumes being tracked and reconciled through the CoC system. While such an approach may support certain objectives (e.g. enabling investment in supply chains or premium payouts,

or is in a context where there is no market demand for a certain product group with specified characteristics), such non-proportional distribution can undermine the credibility of the CoC system, and should be avoided where possible, and clearly justified and controlled when allowed. Such non-proportional distribution may be inadequate when the CoC system is used for other purposes, such as for scope 3 emissions accounting.

Figure 8 – Example of non-proportional distribution in soy supply chain



1.6.2 Attribution within a product group

In mixed CoC systems, specified characteristics can be attributed to outputs within a product group in two ways:

Proportional attribution: where specified characteristics are distributed evenly across all outputs associated with a manufacturing process, mirroring the physical blend or flow of materials – i.e. each unit of output reflects an equal share of the input material, and corresponding attributes. The approach maintains a physical relationship between

characteristics and the material. This method can be applied at batch and site-level transfer boundaries, and is the defining feature of the controlled blending CoC model.

Non-proportional attribution: where specified characteristics are not distributed evenly across all outputs associated with a manufacturing process. This may be used when a batch is split to fulfil multiple customer orders, or where only some customers require material with specified characteristics.

Figure 9 – Example of proportional attribution and non-proportional attribution

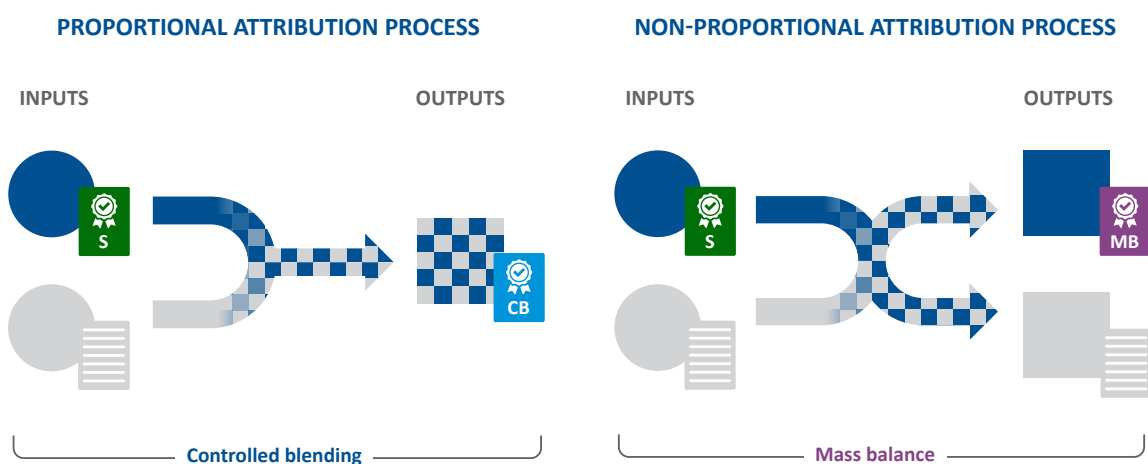
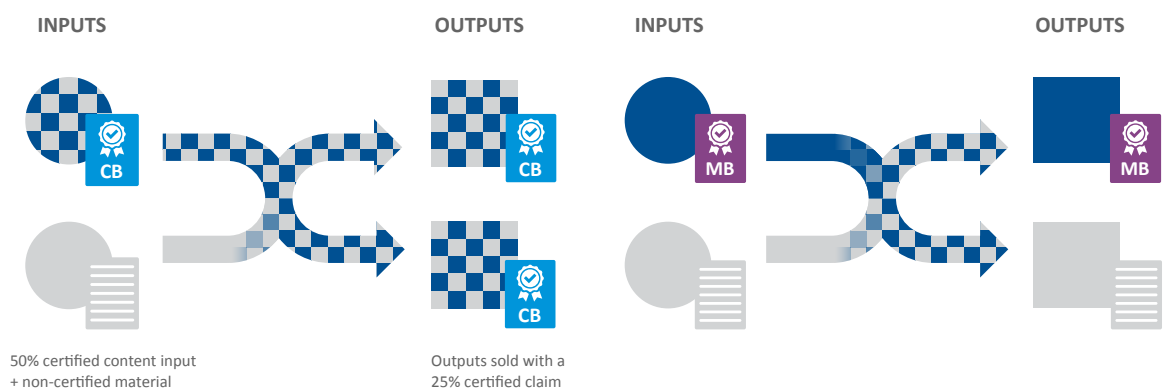


Figure 10 – Side-by-side example of proportional attribution with controlled blended input materials (left), and non-proportional attribution with mass balance input (right)



1.7 Separation methods in segregated CoC systems

Within segregated CoC systems, supply chain entities are required to maintain separation of material with specified characteristics from material without specified characteristics. This separation can be achieved through the following methods:

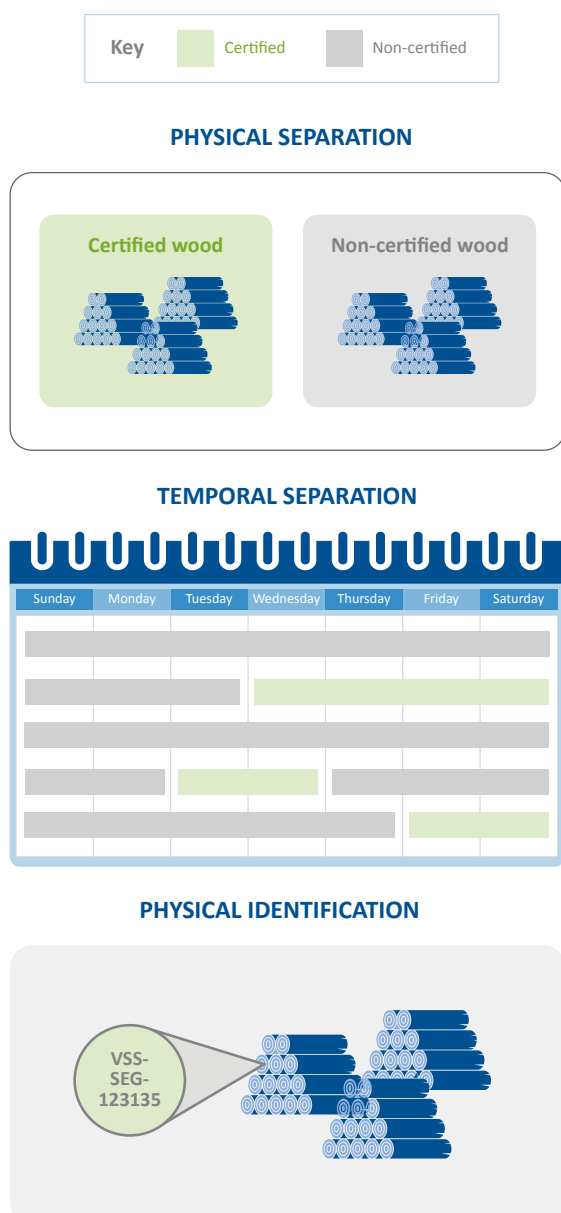
Physical separation: where material with specified characteristics is kept in a designated separate area in a warehouse or within a manufacturing site, or transported separate to material without specified characteristics.

Temporal separation: where entities may alternate the storing and processing of materials with specified characteristics for a given

order or series of orders, in the same storage area / manufacturing facility. They do so by specifying a time period during which material with specified characteristics is stored or used.

Physical identification: Material with specified characteristics must be identifiable at all times during purchasing, storage, handling, production and sale. This can be achieved through a numerical labelling and identification system, or through other identifiers including colour codes, signs, labels, RFIDs, and barcodes. The minimum scale (e.g. batch or SKU) at which identification is maintained will depend on the requirements of the CoC system.

Figure 11 – Separation methods in segregated CoC systems



1.8 Verification in CoC systems

Verifying the correct application of a CoC system by a supply chain organisation is important for the credibility of transferred volumes and product-level claims.

The approach needed to effectively verify CoC is dependent on a range of factors, which influence how the verification process is structured. These factors include:

- The specified characteristics being tracked through the supply chain, and CoC models used
- Standard requirements and scheme rules
- The nature of the materials and supply chain
- The risk of fraud and non-compliance within the supply chain
- Incentives and premiums associated with specified characteristics
- Business expectations and regulatory requirements
- The nature of claims the CoC enables

As such, it's important to highlight that there is no one-size fits all approach to CoC verification.

Within sustainability systems, verifying the application of a CoC system is based on the requirements of the CoC Standard and associated documentation. CoC Standard requirements will usually cover:

- Management systems, procedures, processes and responsibilities (at group and site level)
- Controls on purchasing, material receipt, sales and goods out
- Controls on handling, storage and production
- Controls on out-sourcing and services provision
- Controls on documentation and records
- CoC model specific requirements (e.g. relating to volume reconciliation, separation of materials and attribution methods)

Verification will assess whether the application of the CoC meets specified requirements. Approaches to verifying the correct application of the CoC system may include:



Audits and evaluations



Sampling of transaction and manufacturing records



Tracebacks (where an output is traced back through documentation)



Scientific testing and verification (e.g. isotope and trace element testing, DNA analysis etc.)

Many sustainability systems are investing in volume reconciliation databases and tools, as an effective means of mitigating the risk of volume inflation, substitution and fraud.

For CoC models that require separation of materials, the ability of a supply chain entity to correctly maintain segregation must be verified. More detail on separation methods can be found in sub-section 1.7.

For CoC models that require high levels of internal traceability, the suitability of a supply chain organisation's inventory management system must be verified.

Section 2

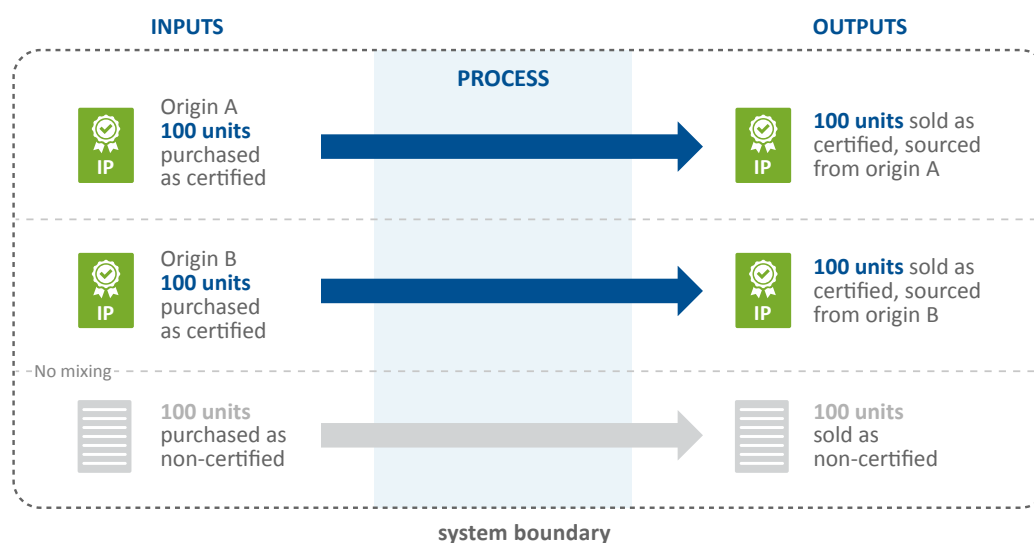
Chain of Custody Models

This section provides an overview of commonly used CoC models, as identified in Section 1. It provides common definitions, key considerations for each CoC model identified, and related terminology and nomenclature. For ease of understanding, the models are described in the context of sustainability systems, where the specified characteristics being tracked are certified volumes.

2.1 Identity Preservation

Definition: A CoC model in which certified materials from a single source are kept physically separate from non-certified materials and materials from different sources, from initial input to final output (adapted from ISO 22095:2020).

Figure 12 – The identity preservation CoC model



Within sustainability systems, the identity preservation CoC model is used to ensure that material originating from a single certified source is kept separate from certified material originating from other sources, and separate from non-certified material through each stage of the supply chain. It is the only model that provides assurance that materials within a particular product originate from a single known certified source or origin.

Identity preservation models are suitable when the nature of the material and supply chain allow this level of separation and identification of materials. They are used to enable 'single origin' claims, and require a high-level of physical identification and control within the supply chain to enable the necessary separation (see sub-section 1.6 for more details on separation methods).

May also be referred to as: IP, Hard IP

KEY CONSIDERATIONS:

- Does not permit the mixing of certified materials of different origins
- Certified physical product and associated product documentation can be traced back to a single point of origin
- The CoC system boundaries for identity preservation can be batch or site-level, depending on the level of identity that is being preserved and the point at which it is applied within the supply chain.
- The relationship between specified characteristics and material is physical
- Each lot, batch, quantity or consignment of certified product is treated separately and clearly

separated in both physical product, and in associated documentation from other certified or non-certified product throughout the supply chain.

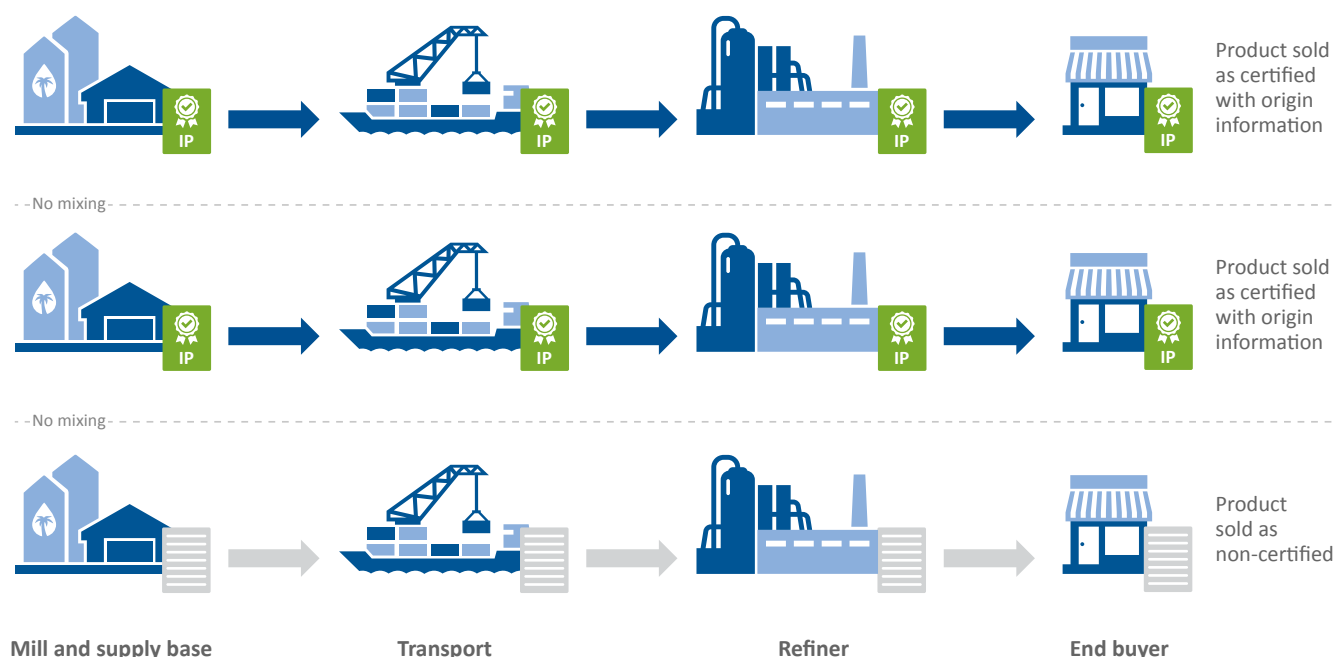
- The granularity of 'source' or 'origin' that the system preserves will vary. Granularity can include: plot (harvested area), farm (land management unit), farm group / cooperative, first point of processing, aggregator / intermediary, sourcing areas, supply shed, landscape, sourcing region and country. These different levels of identity vary significantly – it is important for sustainability systems to be transparent about the level of identity that is maintained through IP systems.

Implications for product-level claims:

Appropriate wording: 'Comes from', 'is from' 'contains', and then the option of stating the specific origin, or just saying 'a certified source / source that meets X requirements'

Claims relating to origin must match the granularity of identity preserved through the CoC system. For example – it would be incorrect to claim that a certified product contains material originating from a specific sub-national region, when the CoC system only preserves country-level origin data.

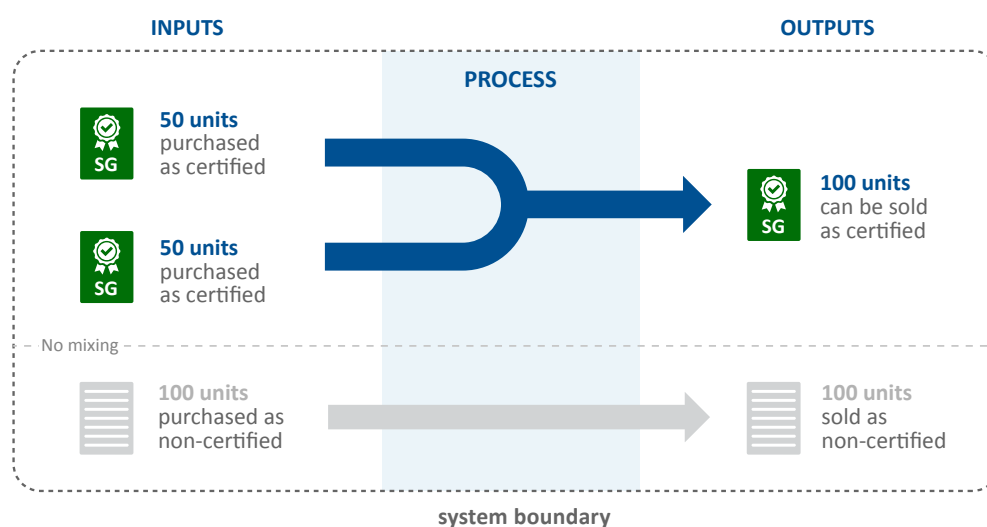
Figure 13 – Example of identity preservation in palm oil



2.2 Segregation

Definition: A CoC model in which certified materials are kept physically separate from non-certified materials from initial input to the final output (adapted from ISO 22095:2020).

Figure 14 – The segregation CoC model



Within sustainability systems, segregated CoC systems are used to ensure that product originating from certified sources is kept separate from non-certified sources through each stage of the supply chain, providing assurance that relevant materials within a particular product originates from certified sources.

Segregated CoC models are used to ensure there is no cross-contamination with non-certified material. The model is

suitable when there is sufficient certified material (at the right time, place, quality) to justify separate storage, processing and transportation. It also requires that supply chain entities have the physical infrastructure required to maintain the necessary separation (see sub-section 1.6 for more information on separation methods).

May also be referred to as: Soft IP, separated, mixed IP

KEY CONSIDERATIONS:

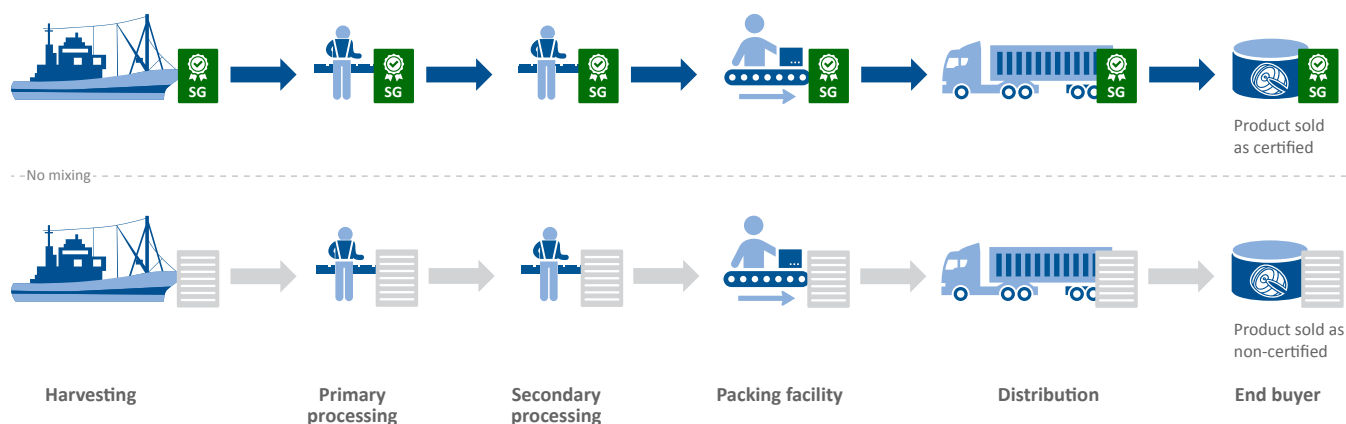
- Permits the mixing of certified material of different origins, but not of certified and non-certified materials
- The CoC system boundaries for segregation can be batch or site-level
- The relationship between specified characteristics and material is physical
- Supply chain entities must control and track the arrival and identity of materials, according to the requirements of the segregated CoC system
- Documentation associated with certified physical product clearly distinguishes between certified and non-certified and may be tracked for each individual lot/batch/quantity/consignment of certified physical product separately. The associated documentation refers to the mix of lots (etc.) of certified physical product, where relevant.
- In some segregated CoC systems, the origin of mixed segregated materials are controlled and tracked with the material, resulting in a final output of known origins. This is sometimes referred to as **mixed identity preservation**.

Implications for product-level claims:

Appropriate wording: 'contains', then 'a (certified) source' or 'source that meets X requirements'

Claims relating to segregation must not imply identity preservation, unless the system maintains the identity of certified materials in the segregated material – a hybrid model called mixed IP.

Figure 15 – Example of segregation in the tuna supply chain

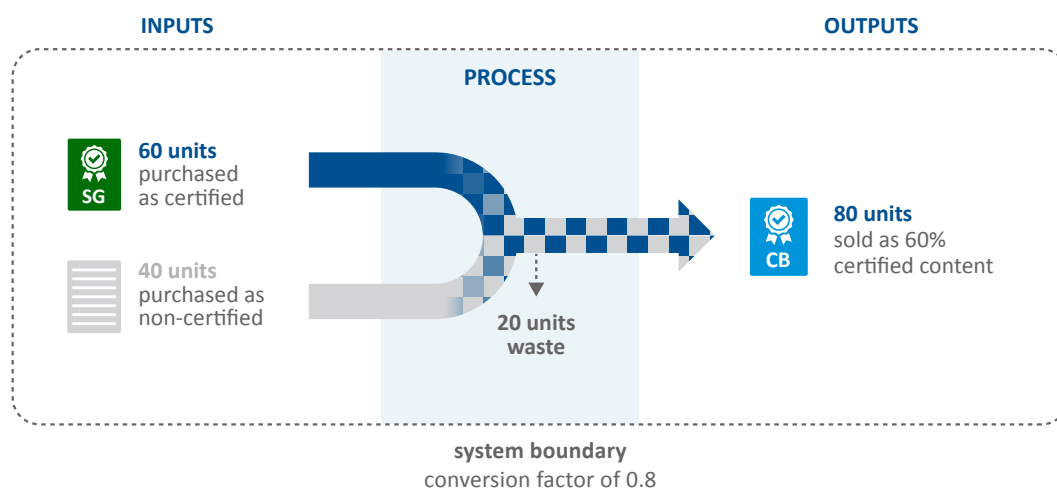


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2.3 Controlled Blending

Definition: A CoC model in which certified input materials are mixed according to certain criteria with non-certified materials or product, resulting in a known proportion of certified materials in the final output (adapted from ISO 22095:2020).

Figure 16 – The controlled blending CoC model



Within sustainability systems, controlled blending CoC systems are used to track and transfer the percentage volume of certified material within a product as it moves through the supply chain. The percentage tracked is usually relative to the volume of certified input material within the product. In certain contexts, it may also be represented relative to the total volume of the product. The percentage can represent a homogeneous blend of materials, or where part of a multi-component product is made of certified material (e.g. a plywood where the inner veneers are made of certified wood). Attribution of specified characteristics under this model is proportional.

Controlled blending is suitable when feedstock from multiple sources (certified and non-certified) are required for a manufacturing process, or when there is insufficient certified materials (at the right time, place, quality) to fulfil an order. It requires a high-level of internal traceability and control within supply chain entities to accurately track the percentage content and maintain unique identification of final outputs.

May also be referred to as: Known-percentage blending, batch percentage blending

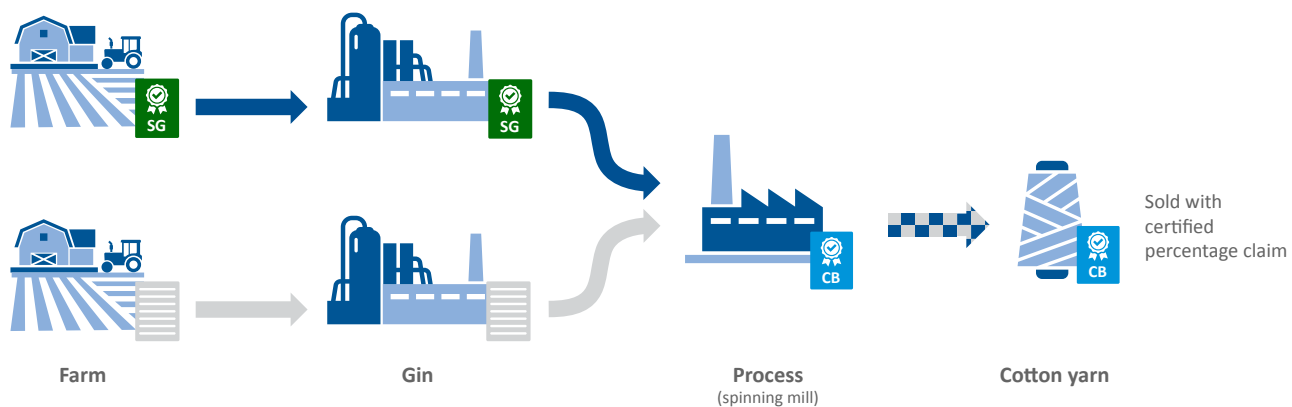
KEY CONSIDERATIONS:

- Permits the blending of certified and non-certified material in known and controlled quantities
- The CoC system boundaries for controlled blending is batch-level. There may be circumstances where only a specific type of process is done at a whole site, and the percentage of blending is known. In this circumstance, it could be possible to apply controlled blending at site-level.
- The relationship between specified characteristics, inputs and outputs must be physical, with proportional attribution of specified characteristics to outputs.
- Supply chain entities seeking to maintain the blend percentages of material sourced under this model must maintain identification and separation of material from other sources as it travels through the supply chain.
- Documentation associated with materials produced under this model must demonstrate the mixing of known volumes of certified and non-certified materials, and track the percentage blend per lot / batch / quantity / consignment.

Implications for product-level claims:

Appropriate wording: 'this product contains X% (of commodity) from certified sources' 'X% of the commodity in this product comes from certified sources'.

Figure 17 – Example of controlled blending of cotton in the textile supply chain

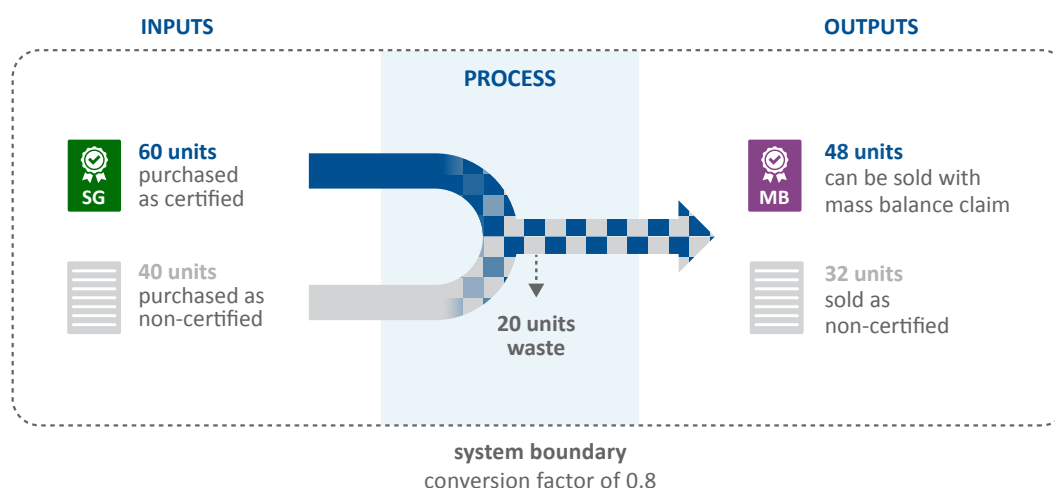


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2.4 Mass Balance

Definition: A CoC model in which certified input materials are mixed according to defined criteria with non-certified materials, and where there is no guarantee of physical presence of specified characteristics in a material (adapted from ISO 22095:2020).

Figure 18 – The mass balance CoC model



The defining characteristic of mass balance CoC models is that there is no guarantee of physical presence of specified characteristics in a material. When mass balance is applied, the physical relationship between material and specified characteristics is lost. The possibility that there is physical presence of specified characteristics in the output will depend on how the mass balance system is designed and implemented. The factors that determine whether the mass balance system maintains physical connectivity are outlined in sections 1.4 – 1.6 of this guidance.

Mass balance CoC systems are used in sustainability systems where it is not technically, operationally, commercially or environmentally feasible to maintain segregation or controlled blending of certified materials. This may be because:

- There is insufficient segregated certified material of the right quality, in the right quantity, at the right time, and at the right place, for manufacturers to meet client orders
- It is not possible to segregate certified material at the beginning of the supply chain,
- It is not economically viable to segregate certified material during transportation and storage
- There are physical constraints on the flow of input and output material within the CoC system boundaries, such

as when they rely on physical infrastructure, relate to a continuous production process, or facilities are geographically dispersed

- There is an absence of demand for fully segregated material

Mass balance is used by sustainability systems to mainstream the trade in certified product, and to create a demand-side pull for certified materials in supply chains where traceability is challenging to maintain.

The model enables organisations of all sizes to make the best use of existing infrastructure, avoiding the introduction of additional costs and complexity that would otherwise discourage the sourcing of certified materials. It is regarded as an inclusive model, that enables smallholders and small / medium-sized enterprises to participate in international markets, and be rewarded for it. Some sustainability systems use mass balance to transfer premiums to the point of origin.

Many sustainability systems introduced mass balance CoC models as part of their Theory of Change to transform markets. Some intended to transition away from mass balance once sufficient segregated volumes were available, or until sufficient actors in the supply chain achieved certified status.

MASS BALANCE IMPLEMENTATION METHODS

ISO/DIS 13662:2025 describes two implementation methods for mass balance:

The **rolling average percentage method**: under this model, time periods are used to determine an average percentage of certified material that can be attributed to output materials. This is based on the percentage of certified material input received during the same time period.

The **credit method**: under this model, organisations set up a credit account for each type of certified input within the mass balance system boundary. Credits are accounted for when certified inputs enter the mass balance system boundary, and are retired once attributed to an output leaving the system boundary.

There are numerous ways to design and implement a mass balance system. Core to this is CoC system boundary of the mass balance system, which defines:

1. the scale of the transfer boundaries (sub-section 1.5.1),
2. the volume reconciliation period and further temporal restrictions (sub-section 1.5.2), and
3. the granularity of product groups tracked within the system (sub-section 1.5.3).

When applied at **batch-level**, the model requires that certified volumes are mixed with non-certified volumes. Certified volumes can then be attributed non-proportionally to resulting output material, per the requirements of the CoC system.

When applied at **site-level**, the model tracks the percentage or input volume of certified materials purchased, in inventory,

used and sold across the entire site during the reconciliation period, without strict batch-level control. Both the rolling average percentage method, and credit method, can be applied at site level. It is possible to transfer certified volumes to output material without there being a manufacturing or transformation process, providing overall quantities are controlled. This would be applicable in the context of storage facilities and distribution centres, using the credit implementation method.

When applied at **multi-site level** and **group-level** using the credit method, the model tracks the input volume of certified materials purchased, in inventory, and used across all participating sites during the reconciliation period. It is possible to transfer certified volumes received at a site to output material leaving another geographically distinct site, though this significantly limits the physical connectivity maintained by the system.

May also be referred to as: mixed or mixing

KEY CONSIDERATIONS:

- Permits the mixing of certified and non-certified material without tracking the known percentage of physical certified material in output materials
- The CoC system boundaries for mass balance can be batch, site, multi-site or group-level
- The mass balance may be implemented via the rolling average percentage method, or the credit method
- There is physical connectivity between the material and specified characteristics
- Attribution of specified characteristics may be non-proportional. Outside of justified and controlled circumstances, the distribution of specified characteristics between co-products should follow related conversion factors. .
- Volumes of inputs and outputs with specified characteristics must be reconciled within a defined volume reconciliation period.
- In complex supply chains, materials may go through a mass balance CoC multiple times. The longer the supply chain, the weaker the physical connectivity between specified characteristics and materials.
- The associated documentation required will depend on whether the mass balance approach is applied at batch, site, multi-site or group level. At site, multi-site and group level, documentation of overall purchases and sales of materials with specified characteristics must be maintained by product group. In addition, when applied at batch level, documentation is required relating to the mix of lots / batches / quantities / consignments of materials with specified characteristics and material without specified characteristics.

Implications for product-level claims:

Appropriate wording: 'supports the production of certified materials', 'contributes to the production of', 'sourced through

a mass balance approach'. When a product is sourced as mass balance, claims must not imply that the product comes from a certified source, or contains certified material.

Figure 19 – Example of mass balance of aluminum foil at batch / site level

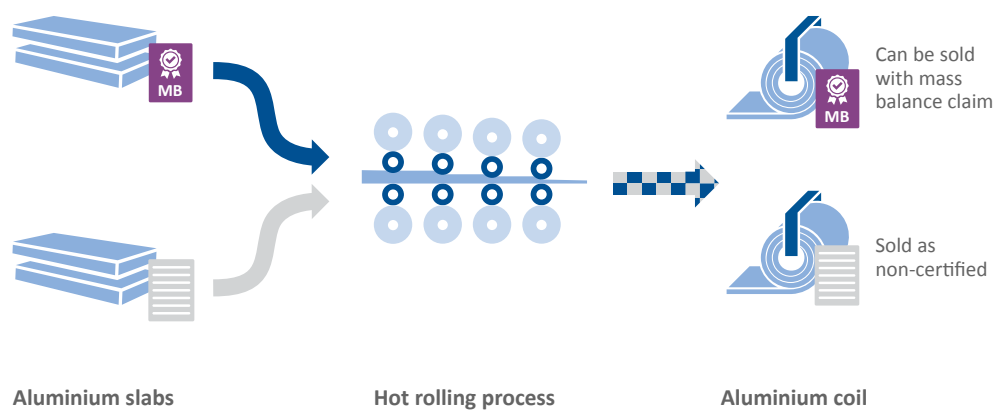
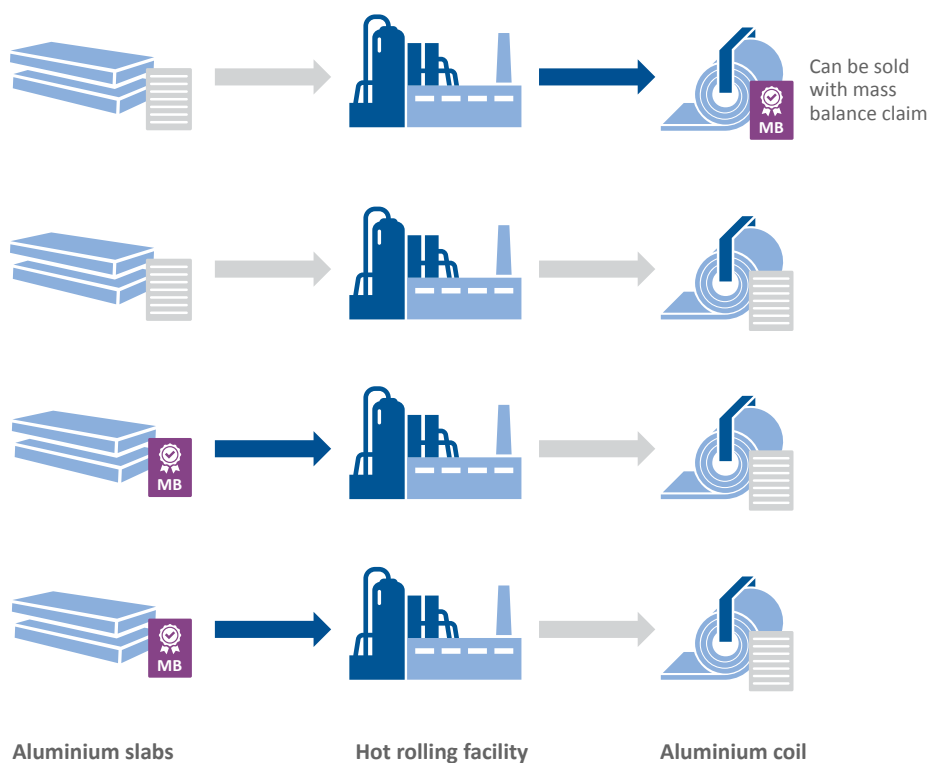


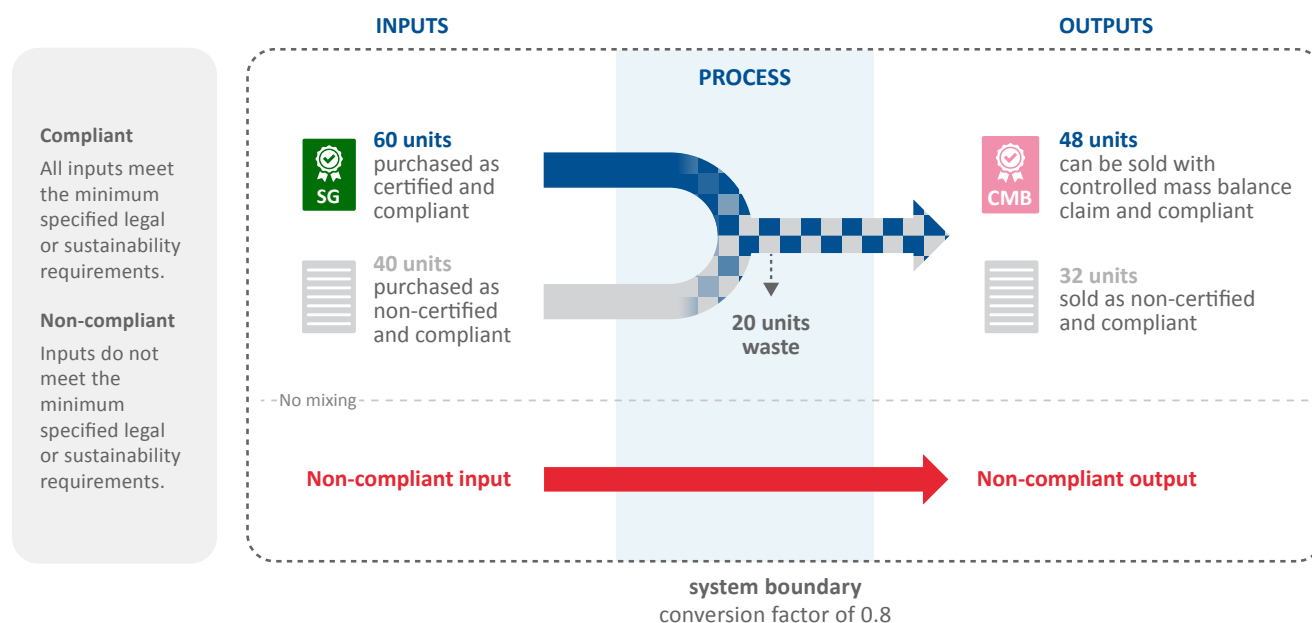
Figure 20 – Example of mass balance of aluminum foil at multi-site / group level



2.5 Controlled Mass Balance

Definition: A variation of mass balance, where all input material entering the system boundary has specific attributes – most commonly that all the material, whether certified or not, is compliant with a set of minimum specified legal or sustainability requirements.

Figure 21 – Abstract representation of controlled mass balance



NOTE 1: Controlled mass balance is not a distinct CoC model – it is a hybrid approach that combines elements of segregation and mass balance. The model is presented separately in this document as it serves a significantly different function to traditional mass balance and segregation models used by sustainability systems.

NOTE 2: The use of the term 'controlled' is not intended to imply that traditional mass balance is uncontrolled – credible mass balance implementation requires supply chain

organisations to implement robust accounting and volume reconciliation processes.

A controlled mass balance approach can support better alignment between mass balance systems and stakeholder needs, particularly in the context of regulatory compliance, such as with corporate due diligence regulation, where a company wishes to mix certified and non-certified input, but all input needs to meet certain minimum legal or sustainability requirements.

THE DIFFERENCE BETWEEN CONTROLLED MASS BALANCE AND CONTROLLED BLENDING

The term *controlled* can have different meanings depending on the context.

In **controlled mass balance**, controlled refers to ensuring that all volumes—certified and non-certified—meet a defined set of minimum legal or sustainability requirements.

In **controlled blending**, controlled refers to the ability of supply chain organizations to blend materials with precision, resulting in a known and verifiable percentage of certified and non-certified content in the final output.

In the context of sustainability systems, a controlled mass balance approach tracks two different attributes:

- **Compliant volumes:** That all input entering the CoC system boundary meets specified minimum requirements. This compliance attribute is intrinsic to the material, and is tracked as a physical relationship.
- **Certified volumes:** allows for the mixing of certified and non-certified input materials, and for certified volumes to be attributed to output material within the CoC system boundary. The relationship does not need to be physical, but both certified and non-certified input must meet the specified minimum requirements.

For compliant volumes, the sustainability system should define or reference (e.g. from an applicable regulation) the controlled mass balance input requirements. They should also define how compliant volumes should be assessed and verified, usually through a risk-based approach. In some contexts, a 'low risk' or 'mitigated risk' designation may be sufficient to qualify as compliant. In others, demonstrating 'negligible risk' and 'no risk' may be required – approaches that require a much higher evidence threshold.

For example, if a controlled mass balance approach was introduced to support the EU Deforestation Regulation, then

material traded as compliant would need to be 1) deforestation-free, 2) legally produced, and 3) be tracked with sufficient verified evidence and data to generate a due diligence statement by operators placing the material on the market.

For sustainability systems, control of non-certified input may be achieved through:

- Recognition of other certification schemes as equivalent
- Area-level monitoring and control (more suitable for upstream companies, when traceability back to production unit is not known, but traceability to a spatially defined region is known)
- Supplier control and management (more suitable for downstream companies that rely on their suppliers to monitor and provide evidence of compliance)

May also be referred to as: controlled mix, compliant mix

Implications for product-related claims:

Appropriate wording: 'supports the production of', 'contributes to the production of'

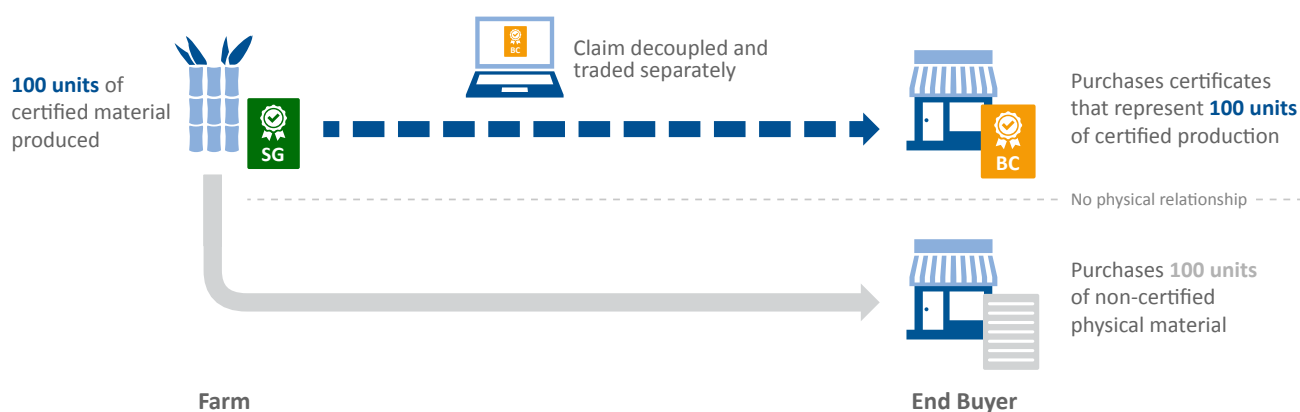
Further product-related claims may be possible, depending on the compliance status of all material in the mix.



2.6 Book and Claim

Definition: A model in which the transfer of certified volumes are decoupled from the physical flow of material or product through the supply chain (adapted from ISO 22095).

Figure 22 – The book and claim model



Under this model, certified volumes are completely dissociated from physical material, generating volume-based certificates which are traded independent of

physical material. Certificates can carry additional information (e.g. origin, harvest year, other sustainability data).

IS BOOK AND CLAIM A CoC MODEL?

The book and claim model is an outlier among CoC models, as the attributes it transfers are not physically associated with material moving through the supply chain. Consequently, it does not meet standard definitions of a CoC model and is often not classified as one—despite serving a similar purpose.

Many sustainability systems that offer book and claim also enable physical and mass balance CoC models. In such instances, the accounting of certified materials must consider all relevant models, including book and claim. Regardless of whether it qualifies as a true CoC model, book and claim must be included in any comprehensive discussion of CoC models and sustainability systems.

When volumes are traded as certificates, an equivalent volume of material must be traded as non-certified by the producer / manufacturer. If this logic is not followed, it results in double counting of volumes within the CoC system.

In some book and claim systems, certificates can be attributed to materials as they flow through the supply chain. In others, only end buyers can purchase certificates. In both instances, it is important to apply appropriate conversion factors to determine the equivalency between the certified material and each relevant output.

Book and claim systems may allow the generation of different certificate-types per co-product. Where this occurs, the system should apply proportional distribution of certificates per co-product / product group, and consider conversion factors where relevant.

Certificates can be purchased and retired (removing them from circulation, and claimed by the market actor who retires them) by supply chain entities and end-buyers. In some systems, certificates can be re-sold by market actors. Certificates that have been retired must not be re-sold.

Book and claim systems require:

1. A registry, which tracks the issuance, holding, transfer and retirement of certificates – this serves as a single source of truth regarding the status of certificates generated by the system, and underpins volume reconciliation
2. A market function, or other means for the trading of certificates by defined market participants

Certificate trading is widely used by many manufacturers and end companies to meet their sustainable sourcing targets, especially when sourcing certified volumes is not possible. The model can be used to encourage more sustainable production among producers who are unable to connect to international supply chains. However, it should be noted that when certificate trading is used as part of a sustainable sourcing strategy, end products may contain no known certified product, and there may not be physical traceability through the supply chain.

Some sustainability systems are also introducing credit-trading systems, where credits represent impact metrics such as 1 kg CO₂e reduced / removed. When introducing such models, sustainability systems must implement controls to prevent double counting of sustainability attributes across certified volumes and credits.

Related terms: book and claim, certificate trading, credit trading

KEY CONSIDERATIONS:

- Provides tradable certificates for certified product to the supply chain.
- When certificates are traded as book and claim, a corresponding volume of material must be sold in the supply chain as non-certified
- Requires a registry that tracks the issuance, holding, transfer and retirement of certificates.

This provides accountability and prevents the re-trading of certificates that have already been claimed.

- Allows for the claim to be decoupled from the certified material
- Intended to reward responsible production where the physical supply chains make sourcing the actual product very difficult.

Implications for product-related claims:

Claims implying a link between specific materials and certificates purchased through book and claim systems must be avoided.



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