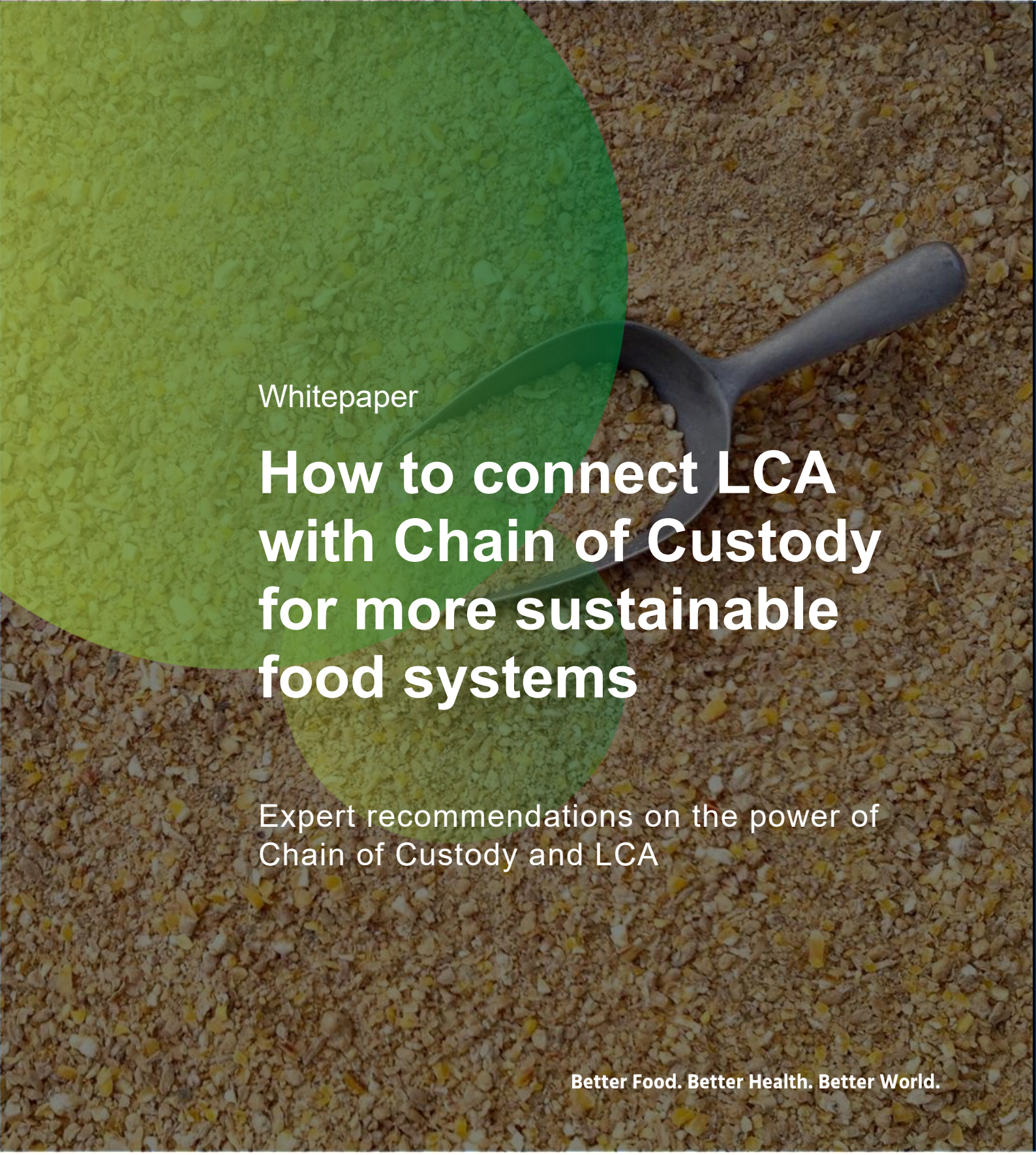

Whitepaper

How to connect LCA with Chain of Custody for more sustainable food systems

Expert recommendations on the power of Chain of Custody and LCA

Better Food. Better Health. Better World.

Mérieux NutriSciences | Blonk

www.blonksustainability.nl

About us

Mérieux NutriSciences | Blonk is a leading international expert in food system sustainability, inspiring and enabling the agri-food sector to give shape to sustainability. Our purpose is to create a sustainable and healthy planet for current and future generations. We support organizations in understanding their environmental impact in the agri-food value chain by offering advice and developing tailored software tools based on the latest scientific developments and data.

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1. Introduction

As sustainability becomes part of the agri-food sector's core values, companies are increasingly seeking credible, data-driven ways to demonstrate real impact. Most agri-food companies have now performed their environmental inventories and set ambitious climate targets. However, in doing so, they have found that their hotspots are located deep within the supply chain, far from their direct operations. While companies are under pressure to reduce their emissions, they face many challenges. Financial incentives and robust claims could drive the start in getting real data from the supply chain and accomplish real reductions. To achieve this, a system is needed that connects sustainability commitments to verified supply-chain data, ensuring that inputs are credibly sourced, traced, and accounted for. Chain of Custody (CoC) models play a key role in this regard, as they track and monitor materials or products throughout the entire supply chain. However, despite their importance, there is currently **no clear guidance on how CoC models should be applied within Life Cycle Assessment (LCA) or product footprint calculations**.

To address this gap, a new ISO standard (ISO 14077) is being developed to establish consistent, internationally recognized guidance. Once published, we will align our approach with this standard. In the meantime, we have outlined **our expert recommendations for applying CoC models in LCAs**, **aligning with existing international LCA and footprint methodologies**.

We believe this whitepaper can support stakeholders across agri-food supply chains to transition toward more sustainable and transparent food systems.

2. Understanding Chain of Custody models in agri-food supply chains

Chain of Custody (CoC) is the process of transferring, monitoring and controlling materials or products, and their associated information, as they move through a supply chain (Figure 1). A CoC is a collaborative effort between all parties in the supply chain, unlocking the power to make a real change. It is a key method to track materials or products with specific sustainability characteristics and substantiate claims about materials or products. The CoC and the associated terminology and models are described in the International Standard for Organization (ISO) 22095. This ISO is the foundation for other standards explaining the CoC, like the reference document of International Social and Environmental Accreditation and Labelling Alliance (ISEAL) and the standard from Round Table and Responsible Soy (RTRS).

Figure 1. Example of a supply chain.

CoC can be an essential instrument for agri-food companies that want to demonstrate sustainability in practice, not just on paper. By tracking raw materials from farm, or point of origin, to finished product, the CoC can verify where ingredients come from and how they are produced. This can, for instance, ensure that agricultural products originate from responsibly managed land, do not contribute to deforestation or are produced with a lower environmental footprint.

ISO 22095 identifies five different types of CoC models[1]:

[1] Definitions adapted from ISO 22095

1. **Identity preserved**: Materials or products with specified characteristics from one source are physically separated from all other sources through the entire supply chain. Their identity and characteristics are fully maintained.
    - Example: Organic coffee beans from one certified farm are kept separate throughout roasting and packaging and sold as ‘single origin’.

2. **Segregated**: Materials or products with specified characteristics, often from different sources, are physically combined, but they are never mixed with materials or products without these specified characteristics. Thus, a segregated flow of materials or products with specified characteristics is established and maintained throughout the supply chain.
    - Example: Several Rainforest Alliance certified cocoa farms supply beans that are processed together but kept apart from non-certified cocoa.

3. **Controlled Blending**: Materials or products with specified characteristics are blended in defined proportions with materials or products without these characteristics, resulting in a known percentage of the specified characteristics in the final product.
    - Example: Textiles are made from 30% organic cotton and 70% conventional cotton by precisely controlling ratios of the two types of cotton ending up in the final product.

4. **Mass Balance**: Materials or products with specified characteristics are mixed, in a limited geographical area and a limited timeframe, with materials or products without these specified characteristics. The final product will have an unknown percentage of the specified characteristics and there is no guarantee of physical presence of the specified characteristics in a specific lot of final product. The Mass Balance model has two implementation methods:
    A. **Rolling average percentage method** – The materials or products entering the supply chain within a specific period of time have fluctuating percentages of the specified characteristics. An average percentage of the specified characteristics is then defined over a specific time frame to be attributed to the output.
        - Example: At a flour mill, the wheat input was on average 40% organic and 60% conventional in one month and the produced flour in that month is sold as 40% organic.
    B. **Credit method** – Credit accounts are considered for all materials or products with specified characteristics coming in and going out each step of the supply chain. These credits are only valid in a specific time frame. The recorded output amount with specified characteristics shall be equivalent to the physical input amount, accounting for any processing conversion factors (i.e. the ratio between input amount and output amount for a specific processing step).
        - Example: A sugar refinery tracks certified input quantities of sugar beets to ensure that the total certified sugar sold matches what was purchased. 200 kg of sugar can be produced from 1 ton of sugar beets, so the processing conversion factor is 20%. In one month, the refinery purchases 100 tons of certified sugar beets, and the credit account is used to dictate that a total amount of 20 tons of certified sugar is sold in that month.

5. **Book & Claim**: This model aims to ensure that the total amount of materials or products claimed to have specified characteristics is not exceeding the total amount of materials or products produced with these specified characteristics. Note that in this model, the administrative flow of credits is completely decoupled from the physical flow of materials. Double counting of credits shall be avoided, and credits expire after a defined period of time.
    - Example: A company buys Roundtable on Sustainable Palm Oil (RSPO) credits equivalent to the amount of palm oil they use, while the physically purchased palm oil is not necessarily sourced from RSPO certified farms.

When implementing CoC models, we recommend adhering strictly to the five CoC models and their definitions stated in the **ISO 22095 standard** to ensure consistency and robustness. Many

international frameworks, such as ISEAL, explicitly base their requirements on ISO 22095. Citing the original ISO source provides a more robust foundation than relying on secondary paraphrasing.

3. How to connect Chain of Custody to LCA and footprint calculations?

Many companies use **LCA** or **Product Carbon Footprint** (PCF) methodologies to calculate the environmental footprint of their products and assess their sustainability performance. To ensure meaningful and credible results, often the ISO standards on LCA (ISO 14040 and 14044) and carbon footprinting (ISO 14067) are applied. When supply chain partners have a CoC model in place, there is more transparency and insight into the entire supply chain and into the origin of specific materials or products. This can provide more evidence for a sustainability claim and strengthens footprint and LCA calculations resulting from additional primary data availability.

The CoC concept is currently not explicitly part of the ISO standards on LCA and carbon footprinting. The LCA standards ISO 14040, 14044, and 14067 require **physical presence** of the specified characteristics in the final product. Thus, this means that only Identity Preserved, Segregated, and Controlled Blending CoC models are aligned with these LCA standards. The Book & Claim model is not aligned with these ISO standards, since this model completely separates the administrative flow of credits from the physical flow of materials going through the supply chain.

It is less straightforward whether or not the Mass Balance model is aligned with these ISO standards, since physical presence of the specified characteristics in the final product cannot be guaranteed; only a specific lot of final product may have the specified characteristics. Nevertheless, the probability of physical presence of the specified characteristics in the final product could be increased by setting up a Mass Balance model under controlled conditions. For example, by limiting the geographical area and time period for which the Mass Balance is applied. A summary of the CoC models and their alignment with the ISO standards on LCA and carbon footprinting.

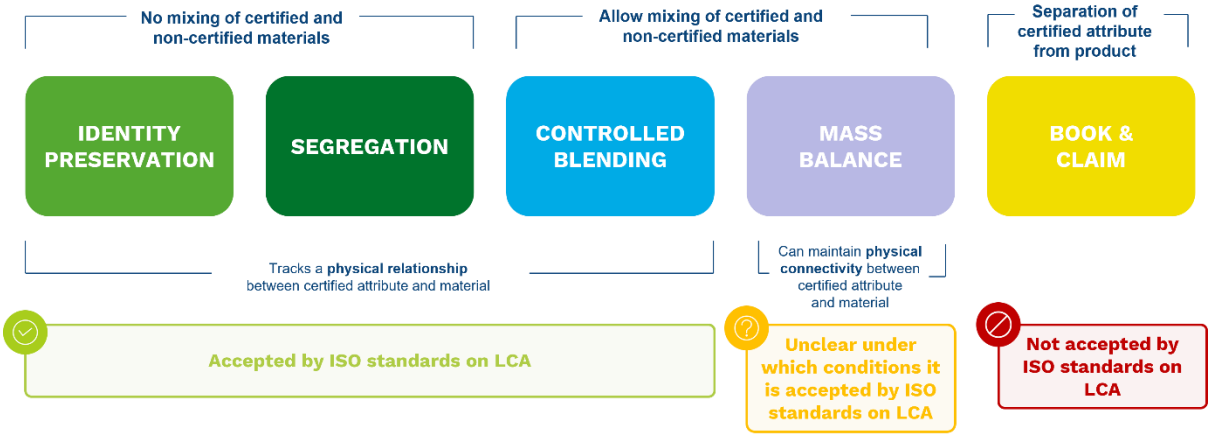

Figure 2 Overview of the five CoC models of ISO 22095 and alignment with ISO standards on LCA (ISO 14040 and ISO 14044) and on carbon footprinting (ISO 14067) (Adapted from: ISEAL Alliance (2025), Chain of Custody models and definitions).

3.1 Development of ISO 14077: Chain of Custody in LCA

ISO 14077, formally titled *'Environmental management – Life cycle assessment – Requirements and guidelines for application of Chain of Custody (CoC) approaches in Life Cycle Assessment (LCA)'*, is currently under development. It will fill an important gap: how to apply CoC models in LCA. The standard will provide definitions, calculation methods, and procedures enabling stakeholders to apply recognized CoC models (i.e. ISO 22095) in a way that is consistent with LCA methodology. Our LCA experts serve on the Technical Committee and are closely involved in the development of this new ISO standard.

Pending the publication of this new ISO standard, we are providing our expert recommendations on how to implement the Mass Balance model in LCA. By doing so, we bridge the gap until the new guidelines are released, and support organizations looking to take their next step.

4. Our expert recommendation: Mass Balance under controlled conditions

In supply chains in which it is not feasible (yet) to implement a CoC model that ensures the physical presence of specified characteristics in the final product (i.e. Identity Preserved, Segregated, Controlled Blending), we recommend first applying a **Mass Balance model under controlled conditions**. By setting the right conditions, a Mass Balance model could work and be a valuable first step towards a more sustainable supply chain.

The controlled conditions necessary to make a Mass Balance CoC meaningful in LCA context are specified below. Please note that each supply chain works differently and has its own challenges. Therefore, it is important that each specific supply chain shall set up its own CoC and evaluates each of the conditions below. This evaluation shall ensure that the CoC is properly set up and that the potential environmental benefits can be accounted for in LCAs.

- The **Chain of Custody** is a Mass Balance model that complies with ISO 22095 and includes the following additional conditions:
    - All supply chain partners from raw material production up to the party communicating about the environmental impact of their product are involved in and committed to long-term contracts or partnerships of at least 3 years.
    - A mature track and trace system is implemented at all supply chain partners and audited on a yearly basis to avoid double counting and assure volume reconciliation (i.e. the volume sold with specified characteristics cannot be more than the volume produced with specified characteristics taking processing conversion factors into account).
    - The reporting companies use the residual mix for the environmental footprint of their conventional products to avoid double counting of sustainable characteristics. Note that background datasets may be used for conventional products in case primary data is not available.
- The **Life Cycle Assessment conducted** is externally reviewed and complies with ISO 14040 and 14044 (or with ISO 14067 in case of a product carbon footprint) and includes the following additional conditions:
    - The calculations are in line with the Product Environmental Footprint (PEF) methodology published by the European Commission.
    - The LCA report is publicly available and transparent on the goal, scope, methodology, assumptions, limitations, potential tradeoffs in LCA impact categories, and results.
    - The calculations are based on primary data (company specific data) for at least the cultivation stage, including land use change (LUC), and the animal production stage.
- The **Mass Balance calculation is restricted** by:
    - Proportional distribution of sustainable characteristics between co-products.
        - Example: A company purchases 10 tons of certified soybeans. An input of 1 ton of soybeans leads to an output of 0.4 ton of soybean meal (40%), 0.1 ton of soybean oil (10%), and 0.5 ton of other output including losses. By applying proportional distribution between co-products, the company can sell 4 tons (= 40% * 10 tons) of certified soybean meal and 1 tons (= 10% * 10 tons) of certified soybean oil. Note that selling 5 tons of certified soybean meal and 0 tons of certified soybean oil or using other ratios is not allowed.
    - Technical feasibility of the final product (i.e., the mass balance cannot be used to ‘create’ products that cannot be produced with these specifications).

        - Example: In a production process, at least 5% virgin material is required, and it is impossible to create the final product based on 100% recycled input material. A company uses 10% virgin and 90% recycled material as input to create 100 tons of final product. The company cannot sell 90 tons of product as '100% recycled' and 10 tons as '0% recycled, since this is technically not feasible.
    - A period of maximum one year or one cultivation cycle. It is not possible to transfer 'credits' of sustainable characteristics to a new period.
    - A geographical scope of maximum one country or one sourcing region. A multi-site level mass balance is only acceptable within one country or sourcing region if these sites (1) have similar production processes in terms of inputs, outputs, and processing techniques; and (2) are (partly) sourcing from the origin of the raw materials with specified characteristics.

We see the **Mass Balance model under controlled conditions as an intermediate step towards more physically segregated CoC models**, such as Identity Preserved and Segregated. Conclusions can only be drawn if the supply chain partners work towards a more segregated CoC when operationally feasible, for example in case of growing market demand. By implementing a CoC model and working together with stakeholders on transparent LCAs, supply chain partners can work towards a more sustainable food system.

5. Chain of Custody and LCA in Practice

The current market shows that it is not easy to establish an Identity Preserved or Segregated CoC model due to operational and commercial feasibility and challenges. Also, a Controlled Blending CoC model is difficult to set up for certain supply chains, since this model requires the production process to ensure a specific ratio of input with specified characteristics to end up in each of the final products. One of the first key steps is to work together across the entire supply chain. The case below illustrates how Albert Heijn and the chicken supply chain partners (poultry supplier and processor, feed producer and soy suppliers) worked together to shape a more sustainable soy supply chain.

5.1 Soybeans in Albert Heijn's chicken supply chain

In 2025 we worked together with Dutch retailer Albert Heijn and their chicken supply chain partners to explore the opportunities of a **Mass Balance CoC under controlled conditions** to potentially establish reductions in the supply chain for Albert Heijn's chicken products. In this project we studied what these specific controlled conditions should look like, to be aligned with LCA standards as close as possible. This approach enables Albert Heijn's supply chain partners to use **soybean meal with a lower carbon footprint** without full physical segregation, while building a system and trust to evolve into a Segregated CoC model in the future.

We calculated that the **carbon footprint reduction potential** of specific chicken products is **38%** when using soybean meal with a lower carbon footprint. This case clearly shows that efforts across the whole supply chain can potentially bring significant results, and that together you can achieve more sustainable results than alone.

Read further to learn more about this project: Shaping a sustainable soy supply chain for Albert Heijn's chicken products

6. Frequently Asked Questions

1. **Is a CoC easy to establish?**
    - The ease of establishing a CoC model depends on several factors: willingness, capacity, finances, and collaboration. First, all parties involved need to be willing to make a change and commit themselves to a collaborative goal. Since it takes time to set up a proper CoC, this also requires available capacity and potentially financial investment for external support or contractual agreements within the supply chain. Strong collaboration and communication between all supply chain partners is key to establishing a CoC together. If good relationships exist, solid LCAs and bookkeeping systems are in place, and collaboration between supply chain partners goes smoothly, then setting up a CoC is very doable.
2. **How long does it take to establish a CoC?**
    - The time it takes to establish a CoC depends on the complexity and size of your value chain. The required collaboration could include renewing or setting up contractual agreements throughout the entire supply chain, which can easily take a couple of months. Furthermore, establishing a CoC does require all parties to invest time, so collaborative buy-in is key.
3. **What do I need for a CoC?**
    - Other than willingness, capacity, finances and collaboration (Q1), ISO 22095 provides requirements for establishing a CoC. Requirements for scoping, (top management) responsibilities, implementation procedures, and documentation are laid out in ISO 22095.
4. **Is there documentation required for a CoC?**
    - Yes, creating a CoC requires documentation. The ISO 22095 provides a list of documentation requirements, for example an overview of purchase documents, a summary of roles and responsibilities, a complaints procedure, and a commitment statement of all involved parties.
5. **Can I make claims once I have a CoC in place?**
    - Yes, you can make claims once you have a CoC in place. However, what you can claim and how you shall formulate your claim is dependent on the CoC model in place. For application requirements, the ISO 22095 refers to the ISO/TS 17033, ISEAL and national legislations. For example, according to ISEAL, the following claims can be made for a Mass Balance CoC model: “supports the production of”, “contributes to” or “sourced through a mass balance approach”. Please consult ISO/TS 17033, ISEAL and your national legislations for specific requirements of claims you wish to make.
6. **What is the result of a CoC?**
    - The most important result of a CoC is the collaboration across the supply chain. Supply chain collaborations can be difficult to establish, and worthy of celebration when achieved. Part of this achievement is an increased level of transparency between supply chain partners on for example their way of working or the environmental footprint of their products. Furthermore, a CoC could provide a solid base to make a possible claim (Q5).
7. **Can I establish a CoC in my supply chain?**
    - Yes, probably you can also establish a CoC in your supply chain. Curious where to start and how to approach this? Find our contact details below.
8. **What does the Greenhouse Gas (GHG) Protocol say about the CoC?**
    - The Land Sector and Removals Guidance (LSRG) - part of the GHG Protocol – states that CoC models that ensure physical traceability are allowed to support direct land use change (LUC) accounting. Physical traceability is ensured in identity preserved, segregated, and controlled blending CoC models. Note that these CoC models can only be used for 'deforestation and conversion free’ (DCF) claims if no LUC (i.e. deforestation and other conversions) occurred in the past 20 years. The LSRG clearly indicates that a Book and Claim CoC model cannot be used to support Scope 3 GHG accounting, since the physical and the administrative flow are completely separated in this CoC model. The Mass Balance CoC model is also not allowed, since a physical

link cannot be guaranteed throughout the supply chain. However, the LSRG does acknowledge that mass balance is a common approach in certification programs and that it can (possibly) support the needed level of traceability when double counting is avoided. The LSRG is currently being finalized for publication and is planned to be released at the end of January 2026. This new LSRG publication may include updated guidance regarding CoC models in GHG accounting.

9. **How is the CoC linked to the Science Based Target initiative (SBTi)?**
    - SBTi closely aligns with the GHG Protocol and consequently the regulations set considering the CoC in the LSRG are also applicable for SBTi (Q8).
10. **Are the conditions set by Mérieux NutriSciences | Blonk in line with/allowed by SBTi?**
    - Strictly speaking, a Mass Balance CoC model is not allowed according to the GHG protocol, which is the foundation for GHG accounting for SBTi. The intentions of the controlled conditions set by us are to (1) increase transparency; (2) increase the probability of physical presence of the specified characteristics in the final product; and (3) avoid double counting. The Albert Heijn case study and the controlled conditions were discussed with the authors of the GHG Protocol and with the Value Chain Initiative, and the conclusion was that our approach is more detailed than the current standards describe.

7. More information

Get in touch

Do you want more information on this subject? Or are you curious how to establish a Chain of Custody in your supply chain? Get in touch with Naomi Buijs or Meike Hopman.

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