



# 4C Carbon Footprint Add-On

Version 2.0



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## Abbreviations

|         |  |
|---------|--|
| AU      | Annual updates                                 |
| BP      | Business Partner                               |
| BPM     | Business Partner Map                           |
| CB      | Certification body                             |
| CF      | Carbon Footprint                               |
| CS      | Carbon stock                                   |
| DOM     | Dead organic matter                            |
| EC      | European Commission                            |
| EF      | Emission factor                                |
| FB      | First buyer                                    |
| FF      | Feedstock factor                               |
| GHG     | Greenhouse gas                                 |
| GoO     | Guarantees of Origin                           |
| GWP     | Global warming potential                       |
| IB      | Intermediary buyer                             |
| IPCC    | Intergovernmental Panel on Climate Change      |
| IP_CF   | Carbon Footprint Add-On Improvement Plan       |
| ISO     | International Organization for Standardization |
| ME      | Managing entity                                |
| PAS     | Publicly Available Specification               |
| PPA     | Power Purchase Agreement                       |
| SBTi    | Science Based Targets initiative               |
| SC-Unit | Soil/Climate Homogeneous Unit                  |
| SDG     | Sustainable Development Goals                  |
| SOC     | Soil organic carbon                            |

## Summary of Changes

The following is a summary of all changes in the content of the document to the previous version of the document. Other changes i.e., corrections of spelling mistakes, are not listed.

| Chapter   | Summary of Changes made in Version 2.0   |
|---|--|
| 2. Definitions & Applications                                     | Upgrade to Climate Neutral Coffee is only possible if Climate Friendly status has been reached and is in place. A simultaneous application is then possible.   |
| 3.1 Scope and system boundaries                                   | Additional clarification of warehouses inclusion and those belonging to roastery   |
| 3.3.3 Emission savings from essoc                                 | Rephrasing of definition of <b>n</b> in formula: number of years the improved agricultural management is in place (in years)   |
| 3.3.5 Emissions from Processing (ep)                              | Additional: Electricity used from grid via guarantees of origin (GoO) or power purchase agreement (PPA)  |
| 3.3.7 Further requirements for Producers of Final Coffee Products | Additional: The final entity in the supply chain can also voluntarily include downstream warehouses that are not belonging to the processing site.   |
| 4. Improvement Plan to Reduce GHG Emissions                       | Additional: Final reduction or maintenance (for IB/FB) of emissions needs to be presented at the end of the certification period, reflecting improvement activities from all parts of the certified unit. It is possible that e.g. at farm level there is an increase of emissions due to a measure but a decrease at wet mill level due to another measure as long as the final GHG value for the certified unit is decreased, the certification is valid.  |
| 4.1.2 GHG Emission Reduction Targets                              | Update: The 4C Carbon Footprint Add-on is flexible in terms of reaching an annual reduction target for entities as long as the emissions occurring from green coffee production are reduced. An increase of the carbon footprint at any stage in the production process and during the certification period is not allowed. This is corresponding to the ambition level of the annual linear reduction rate according to the near as well as long-term temperature goal of below 1.5°C. These targets can be set according to any commercial projections or sustainability strategies the company may have, or previous commitments with the SBTi. As the SBTi clearly highlights reduction requirements vary dependent on sector-specific and commodity specific pathways, the minimum reduction target according to 4C CF Add-On are well adhered to coffee sector as well as practical reductions envisaged based on research and practical experience. |
| 5.2.5 Audit Report Evaluation and Certification decision          | Update: As to ensure high quality and reliability of calculations and results and that the individual GHG calculations are done correctly by following the described methodology, all GHG calculations have to be forwarded to 4C for an additional assessment after verification by the CB/auditor. The CB can only make the certification decision after getting the final confirmation by 4C. The reassessment of 4C is mandatory and included in the deadline period of 60 days as stated above.   |
| 5.3 Maintenance of the Carbon Footprint Add-On Certification      | Additional: For the recertification audit, the baseline will be referred to the one calculated during the initial certification. During any interruption after 3 years and continuation of 4C Climate Friendly or Neutral Coffee certification, the baseline of initial certification will be accounted. This implies that no units are allowed to use more inputs (synthetic fertilizers, pesticides etc.) during the interruption period or conducting any activities to increase the emission and   |

|   |   |
|---|---|
|   | <p>calculate a new baseline based on those inputs. This is to ensure that increasing of emissions are no longer allowed.</p> <p>Detail requirements on Annual update of CF in the case of no combination between 4C core audit and CF certification audit: 2 AU_CFs is required after every 12 months of the certification issuance date. AU_CF in this case is no longer needed to coincide with the core 4C audit Annual Update deadlines. The CF certificate remains valid only when the 4C core certificate is valid.</p>   |
| 6. 4C Climate Neutral Coffee Certification          | Additional: Furthermore, 4C Climate Neutral certification ensures that climate neutrality is reached through certified and traceable GHG mitigation projects contributing to the UN Sustainable Development Goals (SDGs) and generation high-quality carbon credits.  |
| 6.1 Carbon Compensation Mechanism                   | Additional: GHG emission compensation or carbon offsetting is also defined as GHG mitigation beyond the value chain to clearly distinguish carbon offsetting from carbon insetting (i.e., GHG mitigation inside the value chain).   |
| 6.1.2 Specific Requirements                         | <p>Update: The upgrade to Climate Neutral coffee is only possible if the Climate Friendly certification has been reached and is in place. For this level of certification, the prerequisite is the GHG emission reduction. In the first years of Climate Friendly certification, the GHG calculation and the implementation of the Improvement Plan (IP_CF) is considered as valid as it proofs the commitment to GHG emission reduction. Therefore, in the first years of the certification, the Climate Neutral certification can be run simultaneously with Climate Friendly certification until the GHG emission reduction is verified. This implies that the entire GHG emission can be compensated in the first years until the GHG emission reduction is verified.</p> <p>In the following years, the emission reduction led by the implemented IP_CF should lead to GHG emission reductions, 5 can be demonstrated in an updated version of the baseline GHG calculation.</p> |
| 7. Logo use and claims                              | Additional: Companies can start to promote their efforts to mitigate climate change from levels of implementation 1 and 2, which can be communicated by certificate holders using the term "4C Verified GHG emissions" or similar claims, as long as they do not convey the message of GHG emission reduction or neutrality and clearly indicate the system boundary of the calculation.  |
| Annex I. Emission Factors                           | <p>Update of emission factors and values.</p> <p>Inclusion of specific fertilizer production emissions for Southeast Asia Region</p>  |
| Annex II. GHG Reduction and carbon removal measures | Added new tables on specific measures   |



# 1 Background and Objectives

As an independent, stakeholder-driven, internationally recognized certification system for the coffee sector, 4C aims to anchor sustainability in coffee supply chains across environmental, social, and economic dimensions.<sup>1</sup> 4C also strives to contribute and support companies in combating climate change, reducing greenhouse gas (GHG) emissions, and working towards the objectives set by the Sustainable Development Goals (SDG).

*The 4C certification system*

With increasing awareness of the impact of global climate change, companies face new challenges of understanding the effects of their operations and implementing measures to contribute to successful climate protection. Brand owners worldwide have expressed their commitment to combat climate change, either through a strategic net-zero target or other climate strategy announcements. It is also likely that stricter regulations will be developed that respond to consumers' demand for sustainably sourced products. Consumers' interest in becoming informed about the carbon footprint of the products they buy is growing steadily.

*Relevance of assessing GHG emissions*

Coffee production shall also contribute to the fight against climate change: GHG emissions are emitted in the cultivation of coffee due to fertilizer and chemical use, energy-consuming machines, land-use change, and wastewater. Especially chemical fertilizers and land-use change are found to be major sources of emissions. In the supply chain, transport emissions and energy consumption in processing units also contribute to GHG emissions. On a global level, agriculture contributes significantly to the total GHG emissions – highlighting the need for immediate and comprehensive action.

*Emission sources*

With the 4C Carbon Footprint Add-On, 4C provides a solution for its system users to address the increasing demand for ascertaining and verifying GHG emissions and their reduction in coffee supply chains.

*The Carbon Footprint Add-On*

This document has the following main purposes:

- describe how GHG emissions and their reduction along the coffee supply chain should be assessed
- set the relevant system boundaries
- provide the methodology for GHG calculations
- describe rules and guidelines for calculating and verifying emissions
- explain the prerequisites and processes for becoming certified under the Carbon Footprint Add-On
- outline carbon offsetting options that can be included to compensate or offset for the GHG emissions that cannot be reduced<sup>2</sup> along the supply chain
- clarify the requirements which shall be fulfilled for the respective claims of “4C Climate Friendly Coffee” or “4C Climate Neutral Coffee”

Measuring and quantifying GHG emissions is necessary to identify the impact of coffee production on the climate. Assessing GHG emissions is the basis for comprehensively evaluating the potential for reductions and identifying where measures should be targeted. Identifying GHG emission reduction measures to decrease the carbon footprint of coffee cultivation and processing and

*Carbon footprint of coffee*

<sup>1</sup> More information are provided here: <https://www.4c-services.org/about/what-is-4c/>.

<sup>2</sup> Emission that cannot be reduced can refer to GHG that are still emitted after the application of the emission reduction measures or to those emissions that for different reasons (e.g., technology constraints, high investments required, etc.) cannot be reduced.

implementing carbon compensation mechanisms for the emissions that cannot be reduced (i.e., carbon offsetting) are key for achieving climate neutrality.

For the development of the Carbon Footprint Add-On, recognized methodologies, standards, and initiatives were researched and considered, such as ISO 14067:2018<sup>3</sup>, GHG Protocol Product Standard<sup>4</sup>, PAS 2050:2011<sup>5</sup>, and several IPCC guidelines.<sup>6</sup> The Carbon Footprint Add-On considers the Science Based Target Initiative (SBTi) guide and the Paris Agreement target to limit global warming to 1.5°C.<sup>7</sup>

*Recognized standards and initiatives*

## 2 Definitions and Applications

The Carbon Footprint Add-On clearly defines the 4C Climate Friendly and Climate Neutral Certification along with their prerequisites. **4C Climate Friendly Coffee** refers to the production and processing of coffee and aims to support market participants in contributing to climate change mitigation by calculating, monitoring, and reducing GHG emissions. Independent third-party audits confirm that GHG emissions have been calculated for certified supply chain actors, including the certified 4C Units for coffee production and the 4C Chain of Custody certified Intermediary Buyers/ Final Buyers. It ensures the monitoring of developments concerning GHG emissions and the commitment to reduce GHG emissions in the future. Therefore, a mandatory improvement plan shall be implemented as part of the application. **4C Climate Neutral Coffee** additionally requires that remaining GHG emissions (or emissions that cannot be reduced) are compensated. Consequently, the upgrade to Climate Neutral is only possible if the Climate Friendly status has been reached and is in place. A simultaneous application is then possible.

*Climate Friendly and Climate Neutral Coffee*

The methodology described in this document can be adopted in four levels of implementation, making it possible to implement the Carbon Footprint Add-On gradually and in different arrangements of the coffee value chain. The four levels of implementation are listed below.

*Four levels of implementation*

- **Level 1:** GHG emissions calculation at the 4C Unit level
- **Level 2:** GHG emissions calculation at the 4C Unit level and Intermediary Buyers
- **Level 3:** level 1 or 2 including the reduction of the GHG emissions
- **Level 4:** level 3 including carbon compensation

All operations and facilities responsible for coffee production and post-harvest processing covered by a 4C certificate are eligible for the application of the Add-On. In other words, Managing Entities of the 4C Units and 4C Chain of Custody certified companies can apply and benefit from the 4C Climate Friendly Coffee & Climate Neutral Coffee Add-On. In addition, final buyers such as roasters can also be included at level 2 and become certified to benefit from this Add-On (see chapter 3.3.7 for further requirements).

*4C Units and 4C Chain of Custody*

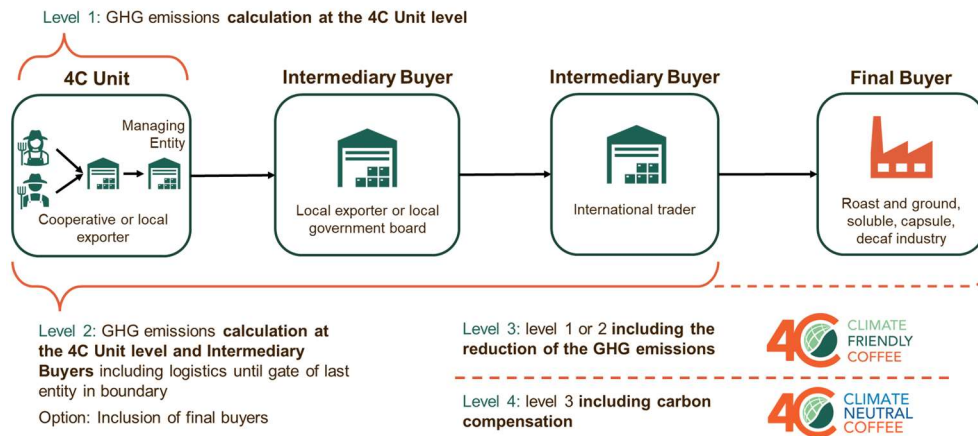
<sup>3</sup> The ISO 14067:2018, from the International Organization for Standardization, provides guidance for the quantification of greenhouse gases for the development of a carbon footprint of a product.

<sup>4</sup> The Product Life Cycle Accounting and Reporting Standard, from the GHG Protocol, is the guideline document stating the requirements for a Life Cycle Analysis of a product.

<sup>5</sup> The PAS 2050:2011, by BSi British Standards, is the Publicly Available Specification (PAS) for the calculation of the greenhouse gas emissions produced during a product's life cycle.

<sup>6</sup> The 2006 IPCC Guidelines for National Greenhouse Gas Inventories and the 2019 Refinement are a nationally recognize methodology for the development of greenhouse gas inventories.

<sup>7</sup> The 1.5°C ambition scenario was the result of a collaboration including UN agencies, businesses, and industry representatives as a way to call for companies in all sectors to commit and contribute to limiting the largest impacts on climate change.



*Figure 1: Four levels of implementation*

The Add-On can either consider the 4C Unit only or the entire supply chain (see chapter 3 for system boundaries). Figure 2: Set-up for GHG emissions calculation for the Add-On on the following page illustrates the overall set-up for applying the Carbon Footprint Add-On.

*Overall set-up*

The Add-On is not mandatory. 4C system users can decide freely whether to assess and reduce GHG emissions in their supply chain with the support of 4C. The Carbon Footprint Add-On is closely aligned with existing certification requirements and procedures under the 4C system. Once all requirements for 4C Climate Friendly (or Neutral) Coffee are successfully fulfilled, a new certificate on 4C Carbon Footprint Add-On will be issued confirming the successful application of the Add-On. Suppose the Add-On is used in combination with an initial 4C core certification. In that case, the initial certificate issued will remain as such as well as the new 4C CF Add-On separately. The 4C system user has the right to use the respective logos and claims and communicate their efforts to reduce GHG emissions.

*Certificate and amendment*

The Add-On can be applied globally, regardless of the type of coffee produced and the cultivation practices. The latest version of this document is available on the 4C website and shall be applied.

*Global application*

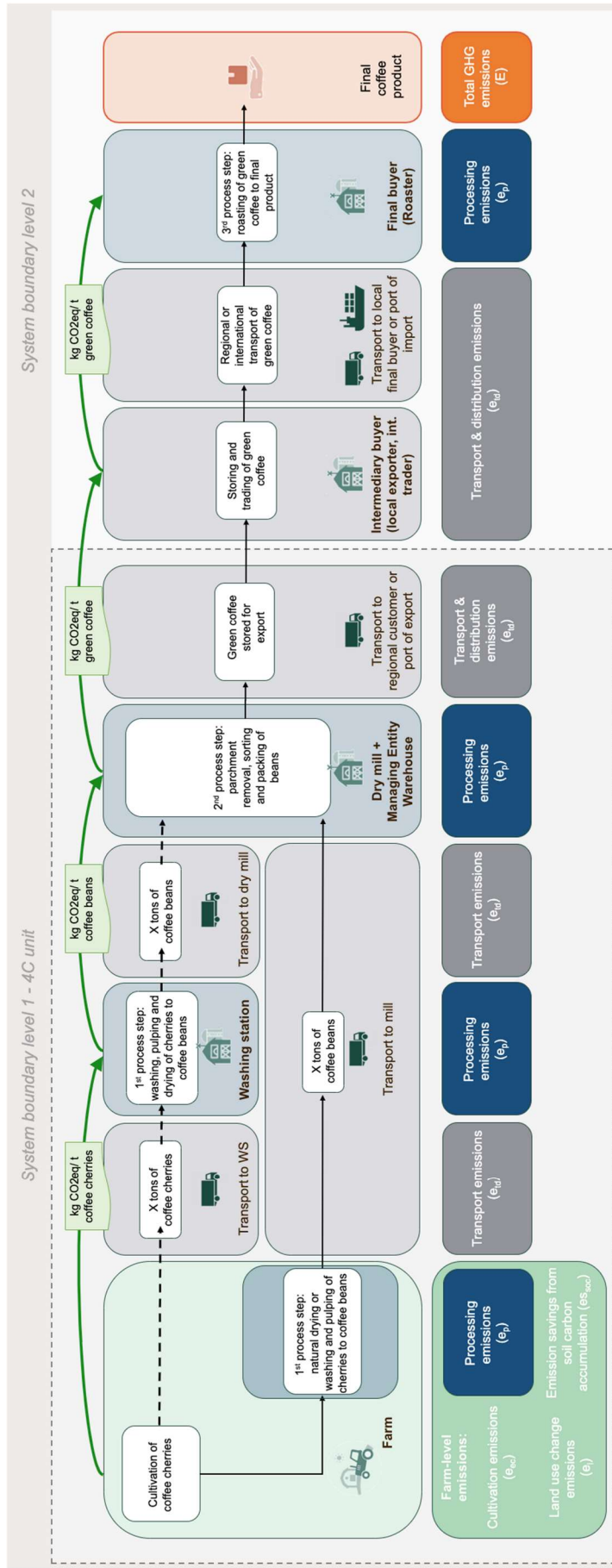


Figure 2: Set-up for GHG emissions calculation for the Add-On

### 3 GHG Emissions Calculation

The following chapter describes the details of the GHG calculation covering the scope for the calculation, data, and methodology requirements. It guides the development of the GHG emissions calculation required as part of the Carbon Footprint Add-On. The certification applicant can perform the calculation (e.g., Managing Entity (ME) of a 4C Unit, Intermediary or Final Buyer) independently or outsource (i.e., consulting company) and it shall be verified by an approved certification body (CB) cooperating with 4C.

Verified  
calculation

#### 3.1 Scope and System Boundaries

Each entity of the supply chain can be covered in the GHG calculation, including the activities of agricultural production, post-harvest processing, storage, transportation, and distribution of the final packaged product, i.e., from the production of the coffee cherries to the roasting of the green coffee. All Business Partners (BPs) of a 4C Unit registered in the Business Partner Map are subject to the GHG calculation. The same logic applies to 4C Chain of Custody certified IB/FB, i.e., all facilities registered in the Business Partner Map for the Chain of Custody should be subject to the GHG calculation. The sampling method and the criteria for selecting Business Partners to be included in the GHG emissions calculation sample are described in chapter 3.2.1.

System  
boundaries

For the Carbon Footprint Add-On, it is required to calculate the individual GHG emissions of the elements within the system boundary of certified 4C Units. Figure 3 shows a simplified supply chain with the elements which shall be included.

GHG emissions  
of 4C Unit

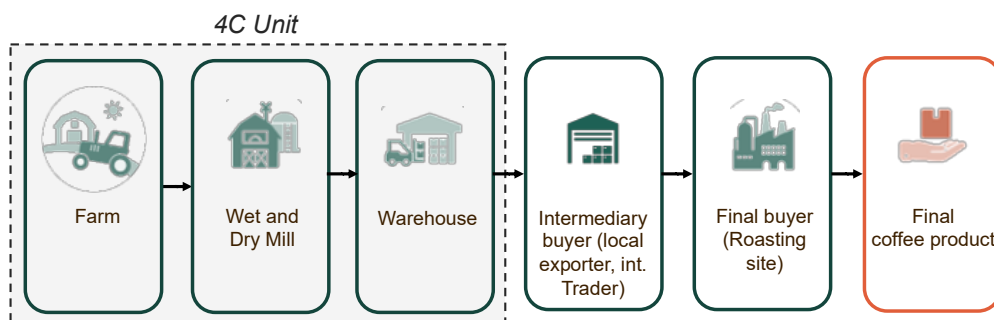


Figure 3: Supply chain steps for GHG calculation

The 4C Unit represents the minimum system boundary (level 1) required to be certified under the Carbon Footprint Add-On and where an individual GHG calculation for each element certified under 4C shall be conducted. To avoid allocation of emissions to possible co-products (i.e., for lateral application of fertilizer in mixed crop scenarios), the system boundaries should be defined in a way that the main coffee product is the main output of the system.<sup>8</sup>

Individual  
calculation  
required

The system boundary<sup>9</sup> for the calculation can be extended to include other elements of the 4C Chain of Custody (see Figure 4 and Figure 5). Logistics between each step in the supply chain also need to be covered in the GHG calculation. Retailers and consumers can receive the final coffee product with a calculated GHG value.

If a Final Buyer requires the entire upstream supply chain to be 4C Climate Friendly (or Neutral) Coffee certified, Intermediary Buyers shall also follow the

Supply chain  
coverage

<sup>8</sup> Greenhouse Gas Protocol. Product Life Cycle Accounting and Reporting Standard. 2011.

<sup>9</sup> System boundary refers to all the entities covered or supply chain components that are accounted for calculation.

methodology of the Carbon Footprint Add-On. In this case, the GHG emissions calculation shall cover additional elements in the supply chain, such as local and/or international logistics and downstream processing activities. Figure 4 illustrates the entire supply chain being 4C Climate Friendly (or Neutral) Coffee certified, including the Intermediary Buyers as system boundary level 2.

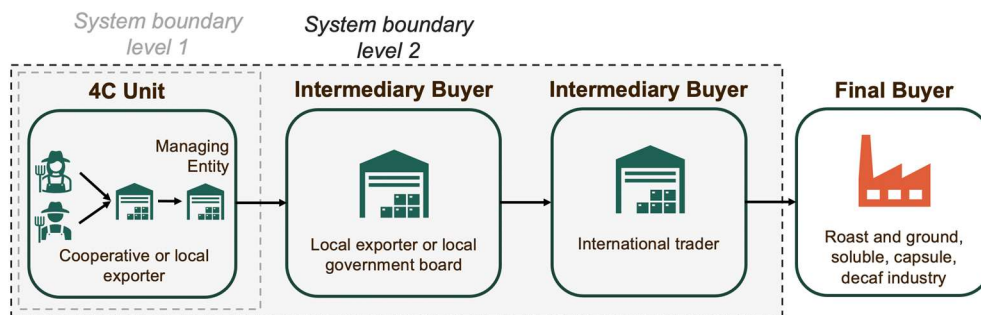


Figure 4: Entire supply chain Add-On certified, including Intermediary Buyer

Optionally, the Final Buyer can also be added to level 2 of the GHG calculation as the last step in the supply chain and be covered by the Carbon Footprint Add-On (see Figure 5). Similar to the Intermediary Buyers, Final Buyers shall also follow the methodology of the Add-On and include additional elements in the GHG calculation, such as upstream international logistics until the factory gate.

Final buyer

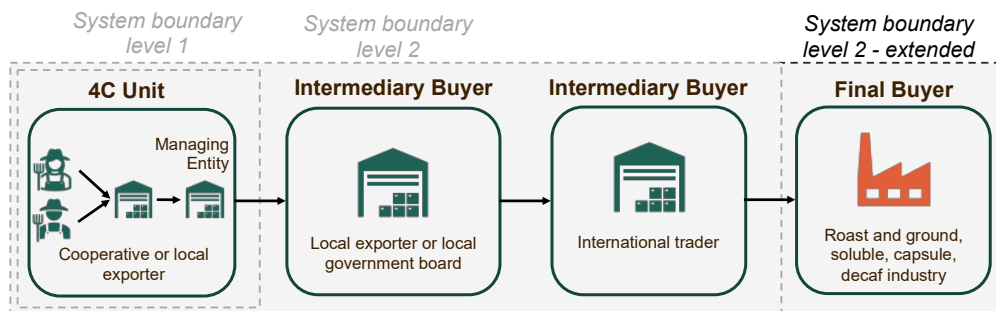


Figure 5: System boundary 2, including the Final Buyer

On-product and off-product claims shall be consistent with both options mentioned above, i.e. 4C Climate Friendly (or Neutral) Coffee, focusing on agricultural production or covering the entire supply chain, optionally including the Final Buyer e.g. roaster. More details about the claims are described in chapter 7.

Claims

### 3.2 Data Requirements

For the calculation of GHG emissions for coffee cultivation and processing, actual data is required. Actual values of emissions can only be determined at the unit that performs the individual GHG calculation i.e., on the farm/ plantation level for the emissions from coffee cultivation. For farm groups this shall be taken over by the responsible ME.

Actual data

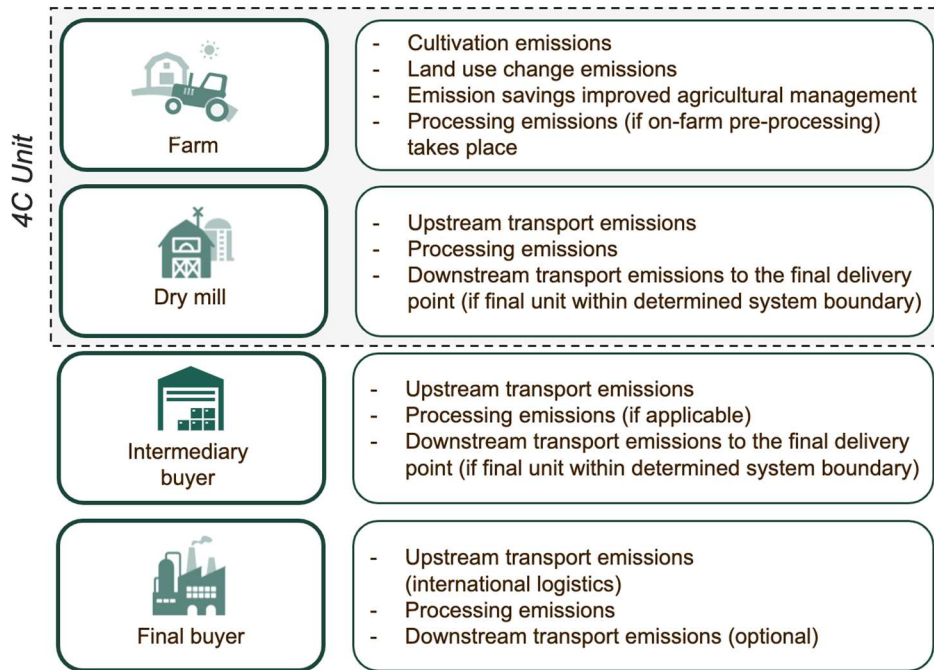


Figure 6: Overview of emissions responsibilities

The **actual values for emissions on farm level** include activities for coffee cultivation ( $e_c$ ) and coffee pre-processing ( $e_p$ ) that occur at the farm and/or plantation level. Farmers or Managing Entities of 4C Units (on behalf of the farmers belonging to the group) can conduct an individual GHG emission calculation for  $e_c$  and  $e_p$ . If, additionally, land-use change ( $e_l$ ) has occurred or improved agricultural management potentially leading to soil carbon accumulation ( $e_{s_{soc}}$ ) is applied, these emissions (or savings in the case of ( $e_{s_{soc}}$ )) also need to be calculated at this step. If farms or plantations belong to a group, they can either conduct an individual GHG emissions calculation for each farmer or one GHG emission calculation for the whole group. In the second case, a sample approach can be used (see chapter 3.2.1).

Coffee cultivation

If there is a **processing facility** (i.e., wet/dry mill, roaster) registered in a certified 4C Unit or in a 4C Chain of Custody certificate, the emissions from processing ( $e_p$ ) shall be calculated. Actual values of emissions from processing shall include all processing activities directly related to the production of coffee.

Processing

Actual values of **emissions from transport and distribution** ( $e_{td}$ ) shall be determined and included in the GHG calculation. Any recipient of physical material shall determine the upstream transport emissions ( $e_{td}$ ) and transmit these values to the next downstream supply chain entity together with the physical product. The final unit within the determined system boundary for the individual calculation shall determine the downstream transport emissions to the final delivery point, whether this is a processing facility, a warehouse, a roaster, or a port in the case of cargo shipments destined for export. In case of international transport, emissions from transport and distribution need to be calculated and included in the calculation by the recipient of the coffee product e.g. the roastery.

Transport and distribution

Storage facilities such as **warehouses** shall be treated separately. If a warehouse belongs to a processing facility, potential emissions shall be covered as part of the calculation for the processing unit under  $e_p$ . Warehouses located at a port belonging to the port infrastructure can be neglected in the GHG calculation as coffee is stored for a short term only before being shipped and

Warehouses

due to lack of data. Independent warehouses between two processing units also do not need to be considered if they are only responsible for logistic activities. In the case of certification, warehouses do not need to be certified separately or provide Sustainability Declarations/Directives, but they will be audited. However, warehouses after the roastery only need to be audited if they belong to the roastery. Warehouses after the roastery can be included voluntarily by the certificate holder, e.g., Final Buyer.



Figure 7: Calculating transport emissions – Example farm to dry mill

### 3.2.1 Sampling

For a 4C Unit covering a group of BP producers, post-harvest processors, and traders, the data basis for the GHG emissions calculation can be based on a sample of relevant BP Producers and BP Processors registered within the 4C Unit, i.e., listed in the Business Partner Map (BPM).<sup>10</sup>

4C Unit

The **sampling methodology for BP Producers** shall be based on the following steps to calculate the minimum sample size for the GHG emissions calculation:

Sample size of GHG calculation

**1<sup>st</sup> Step:** Identification of homogeneous clusters of producers among all BP producers registered in the BPM according to the following criteria:

- coffee yield range
- farm field size
- coffee varieties
- soil type<sup>11</sup>
- use of irrigation
- organic or conventional farming practices
- post-harvest processes that take place inside the farm
  - coffee cherries, i.e., the producer does not carry out any post-harvest processing
  - natural coffee beans, i.e., sun-drying process
  - washed coffee beans, i.e., wet process including washing station with different methods such as honey process, clean parchment, fermentation, etc.

**2<sup>nd</sup> Step:** Calculation of the sample size for each homogeneous cluster identified in the 1<sup>st</sup> step mentioned above, applying the square root of the

<sup>10</sup> Further details on the composition of a 4C Unit, including a description of the different types of business partners and the Business Partner Map (BPM) are available in chapter 4 of the 4C System Regulations and the 4C Glossary.

<sup>11</sup> See COMMISSION DECISION of 10 June 2010 on guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive 2009/28/EC



number of producers included in each cluster. The resulting number should always be rounded up to the nearest whole number.

The **sampling methodology for BP Processors, and for Facilities of Intermediary and Final Buyers** shall be based on the following steps:

*Sampling of BP Processors, of Facilities*

**1<sup>st</sup> Step:** Identification of homogeneous clusters among all processors/facilities registered in the BPM according to the following criteria:

For BP Processors of a 4C unit:

- type of post-harvest processing, i.e., dry process, wet process, dry and wet process
- processing capacity range, i.e., the amount of coffee the facility is capable of processing per year

For Facilities of an IB or an FB:

- type of facilities, i.e., roastery, roastery with grinding or with warehouse, pure warehouse
- processing capacity range, i.e., the amount of coffee the facility is capable of processing per year

**2<sup>nd</sup> Step:** Calculation of the sample size for each homogeneous cluster identified in the 1<sup>st</sup> step mentioned above, applying the square root of the number of processors/facilities included in each cluster from five onwards. The resulting number should always be rounded up to the nearest integer. If a cluster has less than five entries all processors/facilities need to be considered for the sample and data gathering for GHG calculation.

For both producers and processors as well as facilities of IB and FB, the methodology described above defines the minimum sample size. The party responsible for calculating GHG emissions may decide to increase the sample size to improve the representativeness of the sample.

*Sample increase possible*

If there is more than one sample group representing the clusters, a calculation per cluster should be conducted. For each cluster, the final GHG value can be averaged based on the number of farms in the cluster. The final average values of all clusters then need to be weighted to receive one GHG value that can be forwarded in the supply chain to the next entity. The weighting should be based on the produced output of the production stage e.g., the amount of coffee beans per cluster on farm level.

*GHG values of clusters*

4C Units can start with only a part of the producers belonging to the 4C Unit. If this approach is taken, only the coffee produced by this group of farmers can be sold with the specific GHG value. This shall be properly accounted for by the 4C Unit in its traceability documentation. The corresponding bookkeeping will be verified in the 4C audits.

*Certifying part of a 4C Unit*

For guidance regarding the sample for annual updates and recertification audits, please check chapter 5.3.

### 3.2.2 Data Gathering

Data gathering refers to the process of collecting all the information required for the calculation of GHG emissions. On-site data gathering is relevant for actual input and output data, e.g., electricity or diesel consumption, application of pesticides or fertilizers, and output data like wastewater production and treatment. Data obtained on-site shall be recorded and provided to the auditor

*Information sources*

for verification. This can include field record systems, production and harvest reports, production information systems, delivery notes, weighbridge records, contracts, invoices, and others. For the initial GHG calculation, the coffee productivity data (yield) should be the average of the last two or four years to account for low and high productivity years and the change between main crops and fly crops in the harvesting season. The time period analyzed for the following GHG calculation should cover a full twelve-month period and one full harvesting season, but not necessarily one calendar year. The chosen time period and respective data gathered should be as up-to-date as possible. In cases of exceptional maintenance measures and unstable production conditions, a shorter or more distant period (for inputs and respective outputs) may be considered if it better reflects the relevant timeframe. The respective period for data gathering and thus for the calculation of GHG emissions shall be transparently displayed in the calculation.

If an input has little or no effect on generated emissions, it can be excluded from the emission calculation. Inputs with little or no effect are those that have an impact on the overall emissions of the respective calculation formula element (e.g., cultivation  $e_c$ ) lower than 5%. This threshold for relevancy can be determined through a preliminary estimation using other disaggregation criteria. For example, using the volumes of processing inputs consumed to determine if a specific input is consumed in very low quantities (lower than 5% of all processing inputs) and therefore does not contribute significantly to the overall GHG emissions calculated. However, it is recommended to include all inputs in the calculation for the most precise result.

*Inputs with little or no effect*

In addition to the data gathered on-site at the farm or company level, literature data shall be collected for a comprehensive GHG emissions calculation. This includes the emission factors (EF) by which the respective input and output data are multiplied. These should be gathered from official and peer-reviewed sources. Different values may be used but shall be duly justified and flagged in the calculation documentation. They can be based on e.g., Ecoinvent, IPCC, or individually calculated or measured. If not available, other scientifically peer-reviewed literature or official statistical data from government bodies can be used. All data gathered from databases or literature shall be based on the most recent available sources and shall be updated over time. The source and the date of data collection shall be documented. Emission factors chosen or calculated shall also reflect the specific situation and set-up, e.g., if a process-specific input was produced in South America, then the emission factor for this input shall also reflect the South American situation. Only in cases where specific EF are not available, alternative values from other sources can be used if this has been confirmed by the CB.

*Emission factors*

### 3.3 GHG Methodology

The following chapters describe the methodology to calculate the GHG emissions generated from each coffee supply chain step included in the certification. Information on GHG emissions is provided by using actual and individually calculated values. For the time being there are no recognized default values available for the coffee sector which could be used.

*Emission value for green coffee*

The **final unit** for the total GHG emission value shall be **kg CO<sub>2</sub>eq/t or kg CO<sub>2</sub> eq/kg of green coffee**. CO<sub>2</sub>eq or carbon dioxide equivalent refers to the unit of measurement representing the level of global warming potential (GWP) of other greenhouse gases (e.g., CH<sub>4</sub>, N<sub>2</sub>O), expressed in terms of the GWP of one unit of carbon dioxide. For downstream conversion and transportation/distribution of coffee please see chapter 3.3.6 for specific requirements on forwarding.

*Unit of measurement*

The quantification of GHG emissions from the coffee supply chain steps shall contain the following elements:

*GHG calculation  
formula  
elements*

$$E = e_c + e_l + e_p + e_{td} - e_{s_{soc}}$$

Where:

|                                    |  |
|------------------------------------|--|
| <i>E</i>                           | <i>total emissions from the coffee supply chain (kg CO<sub>2</sub>eq/t of green coffee),</i> |
| <i>e<sub>c</sub></i>               | <i>emissions from the cultivation of coffee,</i>   |
| <i>e<sub>l</sub></i>               | <i>annualized emissions from carbon stock changes caused by land-use change,</i>             |
| <i>e<sub>p</sub></i>               | <i>emissions from processing (dry milling, wet milling, roasting, etc),</i>                  |
| <i>e<sub>td</sub></i>              | <i>emissions from transport and distribution,</i>  |
| <i>e<sub>s<sub>soc</sub></sub></i> | <i>emission savings from soil carbon accumulation via improved agricultural management.</i>  |

Emissions from the manufacture of machinery and equipment are not required to be included, in line with the ISO and PAS approach.<sup>12</sup> The same applies to activities that are not directly connected to the coffee cultivation or production process e.g., transport of workers and office activities.

*Machinery and  
equipment*

GHG calculations need to be in line with the methodological requirements of this document. The GHG emission calculation methodology presented in this document is aligned with international standards and protocols. The most known and widespread standards and methodologies were compared and benchmarked to identify similarities and differences, focusing on the calculation requirements and scope of the carbon footprint of a product. As a result, the methodology for the Carbon Footprint Add-On is aligned with the following standards and methodologies:

*Aligned  
approach*

- ISO 14067:2018 - Carbon footprint of products<sup>13</sup>
- GHG Protocol Product Standard<sup>14</sup>
- PAS 2050:2011<sup>15</sup>
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories and 2019 IPCC refinement<sup>16</sup>

In addition to the previously mentioned standards and methodologies, the Carbon Footprint Add-On is also aligned with the 1.5°C ambition scenario from the Science Based Targets initiative (SBTi). The specific scenario and its target apply to the emission reduction activities that can be implemented. Further information on this can be consulted in chapter 4. With this, 4C seeks to join the global commitments and contributions to limiting the largest impacts on climate change.

*SBTi*

<sup>12</sup> ISO 14067:2018 Section 6.3.2 System boundary, 6.3.4.1 General. PAS 2050:2011 Section 6.4.4 Capital goods.

<sup>14</sup>International Standard ISO 14067:2018. Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification.

<sup>14</sup> Greenhouse Gas Protocol. Product Life Cycle Accounting and Reporting Standard. 2011.

<sup>15</sup> PAS 2050:2011. Specification for the assessment of the life cycle greenhouse gas emissions of goods and services

<sup>16</sup>2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

This Carbon Footprint Add-On document sets the methodological requirements for a GHG emissions calculation. All requirements of this document shall be covered and all criteria shall be fulfilled to receive the Carbon Footprint Add-On certification.

*Complimentary material*

### 3.3.1 Emissions on Farm Level

The actual values for emissions on the farm level include activities for coffee cultivation ( $e_c$ ) and coffee post-harvest processing ( $e_p$ ) that occur at the farm and/or plantation level.

*Cultivation and post-harvest*

The calculation can be conducted by either the farmer themselves or by the ME of the 4C Unit. All necessary data shall be gathered, including yield, inputs (seeds, fertilizers, plant protection products), crop residues, water usage, electricity, and fuel consumption. In the case where further inputs are used during cultivation, the relevant amounts per hectare and time period shall be documented and included in the calculation. For the yield only, the data input shall be averaged over the last three years to account for potential variations in yield.

*Calculation*

This data will form the basis for the calculation of GHG emissions for an individual farm. All input values shall be obtained for the same area and time period, e.g., a farm area of one hectare over a time period of one year and season. All farm activities connected to the cultivation of coffee shall be taken into consideration for data gathering, e.g., soil preparation, seedling planting, irrigation, pruning, harvesting, and storage. Domestic use of e.g., energy and water for housing or offices are excluded. The uptake of CO<sub>2</sub> by the coffee plant is also excluded.

*Data requirements*

The calculation formula for cultivation emissions shall contain the following elements:

*Calculation formula*

$$e_c \left[ \frac{\text{kg CO}_2\text{eq}}{\text{ton}} \right] = \frac{(EM_{\text{fertiliser}} + EM_{\text{N}_2\text{O}} + EM_{\text{inputs}} + EM_{\text{fuel}} + EM_{\text{electricity}}) \left[ \frac{\text{kg CO}_2\text{eq}}{\text{ha} * \text{yr}} \right]}{\text{yield coffee cherries} \left[ \frac{\text{tons}}{\text{ha} * \text{yr}} \right]}$$

The sum of GHG emissions from all inputs including fertilizers, plant protection products, seedlings, fuel, and electricity (EM, here in kg CO<sub>2</sub>eq per ha and year) is divided by the yield of coffee cherries in tons per ha and year to receive the specific GHG emissions per ton of coffee cherries.

*Sum of GHG emissions*

The emissions of the different inputs (EM) are calculated by multiplying the input data with the respective emission factors. Care shall be taken that every unit of measurement of on-site gathered data and emission factors from recognized sources are the same. For each input, a respective emission factor shall be applied to calculate the GHG emissions (see Annex I for a list of typical emission factors).

*Different inputs*

If post-harvest processing activities of the coffee cherries take place on the farm level (e.g., cleaning, separation of cherries, de-pulping, washing, mechanical drying) respective emissions shall be stated as processing emissions ( $e_p$ ) and accounted for in the calculation on farm level. For the calculation of processing, emissions see chapter 3.3.5.

*Post-harvest processing*

In the following, the different calculation elements are described in more detail.

*Fertilizer emissions*

The amount of fertilizer used always refers to the main nutrient/active ingredient (e.g., nitrogen).

- For *synthetic fertilizers* (e.g., N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, CaO) emissions from fertilizer production, EM<sub>fertilizer</sub>, shall be considered and specific emission factors, EF<sub>production</sub>, shall be applied.

$$EM_{fertiliser} = \text{fertiliser input} \left[ \frac{\text{kg nutrient}}{\text{ha} * \text{yr}} \right] * EF_{production} \left[ \frac{\text{kg CO}_2\text{eq}}{\text{kg nutrient}} \right]$$

- For *synthetic nitrogen fertilizers*, in addition to EF<sub>production</sub>, N<sub>2</sub>O-field emissions from managed soils, EM<sub>N<sub>2</sub>O</sub> shall be calculated, by applying specific emission factors referring to each different element of N<sub>2</sub>O emission, as specified below.

$$EM_{N_2O} = \left[ E_{N_2O-direct} \left[ \frac{\text{kg N}_2\text{O}}{\text{ha}} \right] + E_{N_2O-indirect} \left[ \frac{\text{kg N}_2\text{O}}{\text{ha}} \right] \right] * 298$$

- For *organic nitrogen fertilizers* and *crop residues* left on the field only N<sub>2</sub>O-field emissions from managed soil shall be calculated. See below for further details.

*Organic fertilizer*

The Intergovernmental Panel on Climate Change (IPCC) has defined a methodology to calculate emissions from the application of fertilizers in the field. This is described in Volume 4, Chapter 11 of 2019 IPCC Refinement which constitutes the reference here. All three IPCC Tiers can be used by BP Producers.

*IPCC method as reference*

The IPCC methodology ensures that N<sub>2</sub>O emissions from soils are properly accounted for, including both “direct” and “indirect” N<sub>2</sub>O emissions from the application of synthetic and organic nitrogen fertilizers and crop residues to managed soil.<sup>17</sup> Direct emissions are those N<sub>2</sub>O emissions directly generated by the soil, because of N input application. Indirect emissions originate from volatilization and subsequent redeposition to soils and waters of ammonia (NH<sub>3</sub>) and nitrogen oxides (NO<sub>x</sub>), generated by managed soils, fossil fuel combustion, and biomass burning. Indirect emissions also include emissions generated after leaching and runoff of N, mainly as NO<sub>3</sub><sup>-</sup>, from managed soils.

*Direct and indirect emissions*

N<sub>2</sub>O emissions shall be calculated and included for both mineral and organic soils (if any). The following formulas refer to mineral soils, which cover most cases. For N<sub>2</sub>O calculation formulas addressing organic soils, please refer to IPCC 2019 Refinement (Chapter 11, Equation 11.1).

*N<sub>2</sub>O emissions for mineral soils*

*N<sub>2</sub>O direct emissions*

<sup>17</sup> IPCC guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 11, [http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4\\_Volume4/V4\\_11\\_Ch11\\_N2O&CO2.pdf](http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_11_Ch11_N2O&CO2.pdf) and “2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories”

For the calculation of N<sub>2</sub>O direct emission, the following formula shall apply:

$$E_{N_2O-direct} = \left[ I_N \left( \frac{kgN}{ha} \right) + F_{ON} \left( \frac{kgN}{ha} \right) + F_{Cr} \left( \frac{kgN}{ha} \right) + F_{SOM} \left( \frac{kgN}{ha} \right) \right] * EF_1 \left( \frac{kg N_2O - N}{kg N} \right) * 44/28$$

Where:

|                   |  |
|-------------------|--|
| $E_{N_2O-direct}$ | Annual direct N <sub>2</sub> O–N emissions produced from mineral managed soils, kg N <sub>2</sub> O ha <sup>-1</sup>   |
| $I_N$             | Total synthetic N-fertilizer input, kg N ha <sup>-1</sup>  |
| $F_{ON}$          | Total organic N-fertilizer input, kg N ha <sup>-1</sup>  |
| $F_{Cr}$          | Total crop residues N-input, kg N ha <sup>-1</sup>   |
| $EF_1$            | Emission factor for N <sub>2</sub> O emissions from N inputs, kg N <sub>2</sub> O-N kg N <sup>-1</sup> . Aggregated default value is equal to 0.01. For further details please refer to Table 11.1 (Updated) of 2019 IPCC Refinement Chapter 11. |
| $F_{SOM}$         | Amount of N in mineral soils that is mineralized, due to loss of soil C from soil organic matter as a result of changes to land use or management, kg N ha <sup>-1</sup> .   |
| 44/28             | Conversion factor to convert N <sub>2</sub> O-N to N <sub>2</sub> O.   |

*N<sub>2</sub>O indirect emissions*

The calculation of N<sub>2</sub>O indirect emissions shall rely on the following formula:

$$E_{N_2O-indirect} = \left[ N_2O - N_{ATD} \left( \frac{kg N_2O - N}{ha} \right) + N_2O - N_L \left( \frac{kg N}{ha} \right) \right] * 44/28$$

Where:

|                     |  |
|---------------------|--|
| $E_{N_2O-indirect}$ | Annual indirect N <sub>2</sub> O–N emissions produced from mineral managed soils, kg N <sub>2</sub> O ha <sup>-1</sup>   |
| $N_2O - N_{ATD}$    | N <sub>2</sub> O emissions produced from atmospheric deposition of ammonia (NH <sub>3</sub> ) and nitrogen oxides (NO <sub>x</sub> ), kg N <sub>2</sub> O-N ha <sup>-1</sup> |
| $N_2O - N_L$        | N <sub>2</sub> O emissions generated from leaching and runoff of N.  |
| 44/28               | Conversion factor to convert N <sub>2</sub> O-N to N <sub>2</sub> O.   |

Detailed formulas and specific emission factors to be used in the calculation of every single element contributing to N<sub>2</sub>O emissions can be found on the IPCC reference document.

*IPCC detailed formulas*

When calculating GHG emissions at cultivation level, emissions from (re-) planting activities and from activities on immature areas shall also be considered.

*Replanting activities*

EM<sub>input</sub> refers to cultivation inputs other than fertilizers e.g., seedlings or plant protection products. For seedlings raised in nursery owned by the BP Producer with seeds coming from the producer's fields, the emission value can be set to 0. In the case of plant protection products, the unit for EM<sub>input</sub> is always kg active ingredient.

*Other input emissions*

$$EM_{inputs} = input \left[ \frac{kg}{ha * yr} \right] * EF_{input} \left[ \frac{kg CO_2eq}{kg} \right]$$

*Fuel emissions*

For calculating  $EM_{fuel}$ , the fuel consumption (e.g., petrol, diesel) of all activities during field-preparation, cultivation, irrigation, harvest, or further post-harvest processing of the coffee cherries shall be determined and multiplied with the emission factor (EF) for the respective fuel used. Fuel consumption data and respective emissions from irrigation practices, other field activities and pre-processing of coffee cherries should be separately collected and calculated.

$$EM_{fuel} = \text{fuel consumption} \left[ \frac{l}{ha * yr} \right] * EF_{fuel} \left[ \frac{kg CO_2eq}{l} \right]$$

If electricity is consumed from the grid, the emission factor of the national electricity mix ( $EF_{electricity}$ ) shall be used. If electricity from renewable sources is consumed directly from the respective electricity plant, an adapted EF for the type of renewable electricity can be used if provided by the plant. If renewable electricity is purchased from an external provider via the national grid and guarantees of origin (GoO) or a power purchase agreement (PPA) are available, the respective EF provided for this electricity (mix) can be used as an alternative to the regular grid EF.

*Electricity emissions*

$$EM_{electricity} = \text{electricity consumption} \left[ \frac{kWh}{ha * yr} \right] * EF_{electricity} \left[ \frac{kg CO_2eq}{kWh} \right]$$

Consumption of fuel for the transport of workers and electricity usage for office buildings are not to be included in the GHG calculation as they are not directly related to the production process of coffee.

*Workers and offices*

A final GHG emission value for cultivation  $e_c$  in  $kgCO_2eq/t$  coffee cherries shall be forwarded to the next supply chain entity together with the coffee cherries.

*Forwarding GHG values*

If post-harvest processing took place on farm level as well, next to emissions from cultivation a final GHG emission value for processing  $e_p$  shall also be forwarded. The final unit for emissions on farm level is  $kgCO_2eq/t$  coffee beans accordingly.

If the calculation is conducted for a sample of BP producers, the GHG value for cultivation emissions can be averaged (based on guidance in 3.2.1.) and shall be forwarded as  $kgCO_2eq/t$  coffee beans or coffee cherries (if no post-harvest processing took place on farm level) following the defined homogeneous sub-groups of the sample.

*Emissions from sample*

### 3.3.2 Emissions from Land-Use Change (e)

The calculation of potential land-use change emissions is mandatory if a change in the use of land took place for the establishment of coffee cultivation and shall be based on the IPCC methodology as a relevant standard (see 3.3.2.1).

*LUC emissions*

Land-use change is meant as a change from one of the following IPCC land cover categories: forest land, grassland, wetlands, settlements, or other lands, to coffee cultivation. Coffee is classified as a perennial crop<sup>18</sup> under IPCC cropland, both when grown in monocultural plantations and in an agroforestry system with shaded coffee trees.<sup>19</sup> Land-use change that can occur for coffee

*IPCC land categories*

<sup>18</sup> Perennial crops are defined as multi-annual crops, the stem of which is usually not annually harvested such as short rotation coppice and oil palm.

<sup>19</sup> "Cropland includes arable and tillable land, rice fields, and agroforestry systems where the vegetation structure falls below the thresholds used for the Forest Land category and is not expected to exceed those thresholds at a later time. Cropland includes all annual and perennial crops as well as temporary fallow land (i.e., land set at rest for one or several years before being cultivated again). Annual crops include cereals, oils seeds, vegetables, root crops and forages. Perennial crops include trees and shrubs, in combination with herbaceous crops (e.g., agroforestry) or as orchards, vineyards and plantations such as cocoa, coffee, tea, oil palm, coconut, rubber trees, and bananas, except where these lands meet the criteria for categorization as Forest Land. Arable land which is normally used for cultivation of annual crops, but which

is mainly a conversion from Forest Land or Grassland to Cropland. However, the GHG emissions from land-use change ( $e_l$ ) of any of the five land categories defined by IPCC to coffee cultivation after the cut-off date of 1 January 2006<sup>20</sup> (same cut-off date as 4C core certification) shall be included.

A change in cropland structure, management activities, tillage practices, or manure input practices is not considered as land-use change and shall fall rather under  $es_{soc}$  (chapter 3.3.3).

For calculating emissions (in kg CO<sub>2</sub>eq/ton of coffee cherries), the change in carbon stocks shall be considered. In the below formula, the carbon stock of the actual land use ( $CS_A$ ) is subtracted from the carbon stock of the reference land use (prior to the land-use change) ( $CS_R$ ), to get the change in carbon stock due to the occurred land use change. The result is divided by the yield of coffee beans and annualized over 20 years. To convert the carbon (C) to CO<sub>2</sub>eq-emissions, the conversion factor of 3.664 shall be applied. The following formula needs to be used:

$$e_l \left[ \frac{kg \ CO_2eq}{ton \ coffee \ cherries} \right] = \left( \frac{CS_R \left[ \frac{kg \ C}{ha} \right] - CS_A \left[ \frac{kg \ C}{ha} \right]}{yield \ coffee \ cherries \left[ \frac{ton}{ha * yr} \right] * 20 [yr]} * 3.664 \right)$$

Where:

- $e_l$  annualized GHG emissions caused by land use change.
- $CS_R$  carbon stock per unit area associated with the reference land use (land carbon stock before conversion into agricultural land) measured as mass (kg) of carbon per unit area, including both soil and vegetation. The reference land use shall be the land use in January 2006 (cut-off date) or 20 years before coffee was harvested, whichever is more recent.
- $CS_A$  carbon stock per unit area associated with the actual land use (carbon stock per unit of land after conversion into agricultural land) measured as mass (kg) of carbon per unit area, including both soil and vegetation. In cases where the carbon stock accumulates over more than one year, the value attributed to  $CS_A$  shall be the estimated stock per unit area after 20 years or when coffee tree reaches maturity, whichever is earlier.
- 3.664 Conversion factor from C to CO<sub>2</sub>eq.

Tier 1, 2 or 3 approach can be used. Tier 1 offers the possibility to use default values provided in the IPCC documents, while Tier 2 and 3 require increasing detail and resources. Tier 3 can imply the use of modelling and geo-referenced datasets, and field measurements. The choice of the most appropriate depends on the scale and data availability.

Together with the batch of coffee beans (or coffee cherries if no post-harvest processing took place on farm level), the farmer forwards to the next supply chain entity inside of the system boundaries the actual GHG value for land-use change  $e_l$  in kg CO<sub>2</sub>eq/ton coffee beans respective coffee cherries.

Structure and practices

$e_l$  formula

IPCC Tier approach

Forwarding respective value

*is temporarily used for forage crops or grazing as part of an annual crop-pasture rotation (mixed system) is included under cropland." IPCC 2006, Vol 4, Chapter 5.*

<sup>20</sup> Different cut off dates, specifically defined by brand owners or companies willing to apply 4C Add-On, may be applied provided that this is clearly communicated to 4C and in B2B and/or B2C communication.



### 3.3.2.1 Calculate Change in Carbon Stock Linked to Land Use Change

To apply  $e_i$  formula, carbon stock in reference land use ( $CS_R$ ) and in the actual land use ( $CS_A$ ) shall be calculated. The carbon stock is defined by the mass of carbon in the soil and in the vegetation, including dead organic matter, per unit of land subject to conversion:

$$CS_i \left[ \frac{kg\ C}{ha} \right] = (C_{veg} + DOM + SOC) * A$$

Where:

|           |   |
|-----------|---|
| $CS_i$    | carbon stock per unit area associated with land use i (reference or actual) measured as mass of carbon per unit area, |
| $C_{veg}$ | carbon stock in above and below ground biomass,   |
| $DOM$     | carbon stock in dead matter,  |
| $SOC$     | carbon stock in soil,   |
| $A$       | converted area (is 1 if whole area is subject to conversion).   |

IPCC 2006 *Guidelines for National Green House Inventories*<sup>21</sup> constitutes the base reference, together with the 2019 *Refinement*<sup>22</sup> for the calculation of change in carbon stocks associated with land use change. The two are complementary and shall be used together. IPCC 2019 in fact refines only some parts of IPCC 2006 guidelines, referring for the rest to IPCC 2006. Volume 4 is the one addressing “Agriculture, Forest and Land Use” to be referred as guidelines for the calculation of  $e_i$  and  $e_{s_{soc}}$  (chapter 3.3.3) for coffee. Chapters 3.3.2 and 3.3.3 are mostly based on chapter 2 “Generic methodologies applicable to multiple land-use categories”<sup>23</sup> and chapter 5 “Cropland”<sup>24</sup> with some additions from chapter 4 “Forest” (IPCC chapter 4).

IPCC 2006 and  
2019 Refinement

Table 1 shows the main references used in this chapter to provide relevant information, with the objective of supporting the calculation of change in carbon stocks driven by land use change. For a thorough calculation it is highly recommended to follow the procedure described in the relevant sections of the IPCC documents.

<sup>21</sup> 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Available at: <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>

<sup>22</sup> IPCC 2019 refinement to 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4 – Agriculture, Forestry and Other Land Use. Available at: <https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/>

<sup>23</sup> Chapter 2: Generic methodologies applicable to multiple land-use categories, Vol. 4. IPCC 2006 and 2019 Refinement. Available respectively at:

[https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4\\_Volume4/V4\\_02\\_Ch2\\_Generic.pdf](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_02_Ch2_Generic.pdf) ; [https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4\\_Volume4/19R\\_V4\\_Ch02\\_Generic%20Methods.pdf](https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch02_Generic%20Methods.pdf)

<sup>24</sup> Chapter 5: Cropland, Vol. 4 IPCC 2006 and 2019 Refinement. Available respectively at: [https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4\\_Volume4/V4\\_05\\_Ch5\\_Cropland.pdf](https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_05_Ch5_Cropland.pdf) ; [https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4\\_Volume4/19R\\_V4\\_Ch05\\_Cropland.pdf](https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch05_Cropland.pdf)

Table 1: Reference to IPCC 2006 Guidelines and 2019 Refinement

Reference to IPCC documents

| Element                        | General methods (Chapter 2)  | Cropland (Chapter 5)                                   | Relevant tables                                   | Tier choice                               |
|--------------------------------|--|--|---|---|
| Above and below ground biomass | Equation 2.15 - 2.16 <sup>a</sup><br>Equation 2.11 - 2.14 <sup>a</sup>                 | Chapter 5.3.1 <sup>b</sup>                             | Table 5.3<br>Table 5.8<br>Table 5.9<br>Table 4.12 | Figure. 2.2                               |
| Dead organic matter            | Equation 2.23 <sup>b</sup>   | Chapter 5.3.2 <sup>b</sup>                             | Table 2.2   | Figure. 2.2.3                             |
| Soil carbon                    | Equation 2.24 <sup>b</sup><br>Equation 2.25 <sup>b</sup><br>Equation 2.26 <sup>b</sup> | Chapter 2.5 <sup>b</sup><br>Chapter 5.3.3 <sup>b</sup> | Table 2.3<br>Table 5.10                           | Figure. 2.4<br>Figure. 2.5<br>Figure. 2.6 |

Note: <sup>a</sup> IPCC 2006, <sup>b</sup> 2019 Refinement.

### Carbon Stock in Above and Below Ground Biomass

Plant biomass constitutes a significant carbon stock in many ecosystems, and coffee is not an exception here. Biomass is present in both the aboveground and belowground parts of coffee plants. Possible land-use changes in the coffee sector include conversion from Forest Land to Cropland. This often results in substantial loss of carbon from the biomass pool, biomass stocks of forest land generally being the largest among land use categories.

Biomass carbon stock

The IPCC provides methods for calculating carbon stock change in biomass due to the conversion of land from Forest and other uses to cropland, including deforestation and conversion of pasture and grazing lands to Cropland. The methods require estimates of carbon in biomass stocks prior to and following conversion, based on estimates of the areas of land converted. The difference between initial and final biomass carbon pools is used to calculate carbon stock change from land-use conversion.

Change in biomass carbon stock

Equation 2.15 in IPCC chapter 2 summarizes the major elements of a first-order estimation of carbon stock change from land use conversion to Cropland and shall be used as reference, for land use change to coffee cultivation. The same equation is used to calculate in Tiers 1, 2 and 3 with some key distinctions for each Tier.

Biomass stock change formula

$$\Delta C_B = \Delta C_G + \Delta C_{CONVERSION} - \Delta C_L$$

Where:

|                         |   |
|-------------------------|---|
| $\Delta C_B$            | annual change in carbon stocks in biomass on land converted to other land-use category, in tons C yr <sup>-1</sup>  |
| $\Delta C_G$            | annual increase in carbon stocks in biomass due to growth on land converted to another land-use category, in tons C yr <sup>-1</sup>  |
| $\Delta C_{CONVERSION}$ | initial change in carbon stocks in biomass on land converted to other land-use category, in tons C yr <sup>-1</sup>   |
| $\Delta C_L$            | annual decrease in biomass carbon stocks due to losses from harvesting, fuel wood gathering and disturbances on land converted to other land-use category, in tons C yr <sup>-1</sup> |

Conversion to Cropland may be associated with a change in biomass stocks, e.g., part of the biomass may be withdrawn through land clearing, restocking or

other human-induced activities. These initial changes in carbon stocks in biomass ( $\Delta C_{CONVERSION}$ ) are calculated with the Equation 2.16 from IPCC chapter 2 below:

$$\Delta C_{CONVERSION} = \sum_i \{ (B_{AFTER_i} - B_{BEFORE_i}) * \Delta A_{TO\_THERS_i} \} * CF$$

Where:

|                          |   |
|--------------------------|---|
| $\Delta C_{CONVERSION}$  | initial change in biomass carbon stocks on land converted to another land category, tons C yr <sup>-1</sup> |
| $B_{AFTER_i}$            | biomass stocks on land type $i$ immediately after the conversion, tons d.m. ha <sup>-1</sup>                |
| $B_{BEFORE_i}$           | biomass stocks on land type $i$ before the conversion, tons d.m. ha <sup>-1</sup>                           |
| $\Delta A_{TO\_THERS_i}$ | area of land use $i$ converted to another land-use category in a certain year, ha yr <sup>-1</sup>          |
| $CF$                     | carbon fraction of dry matter, ton C (ton d.m.) <sup>-1</sup>   |
| $i$                      | type of land use converted to another land-use category.  |

The Tier 1 method follows the approach in IPCC chapter 4 (Forest Land) where the amount of biomass that is cleared for the conversion to Cropland is estimated by multiplying the area converted in one year by the average carbon stock in biomass in the Forest Land prior to conversion.

*IPCC Tier*

Default parameters to support estimation of emissions under a Tier 1 approach are given in Table 4.12 (Updated) in chapter 4 of the 2019 IPCC Guidelines for National Greenhouse Gas Inventories. For monoculture perennial croplands, since there is no parameter defined for coffee, the default parameters of tea or orchard can be used to represent coffee. The default parameters for monoculture perennial croplands are given in Table 5.3 (Updated) in chapter 5 of the 2019 IPCC Guidelines for National Greenhouse Gas Inventories.

*Default parameters*

### Carbon Stock in Dead Organic Matter

Forest Land, Grassland, Settlements, and other land-use categories could be potentially converted to Cropland which, in general will have little or no dead organic matter (DOM), in the form of dead wood or litter (DOM pools), except for agroforestry systems.<sup>25</sup>

*DOM carbon stock*

Equation 2.23 in the IPCC chapter 2 2019 provides the formula for the application of Tier 1 for the estimate of annual change in carbon stock in deadwood and litter, due to land conversion:

*DOM stock change formula*

$$AC_{DOM} = \left( \frac{(C_n - C_o) * A_{on}}{T_{on}} \right)$$

Where:

<sup>25</sup> Agroforestry systems which may be accounted either under Cropland or Forest Land, depending upon definitions adopted by countries for reporting. IPCC 2006, Vol.4, Chapter 5.

|            |  |
|------------|--|
| $AC_{DOM}$ | changes in carbon stocks in dead wood or litter, tons C yr <sup>-1</sup>   |
| $C_o$      | dead wood/litter stock, under the reference land-use category (before land use change occurs), tons C yr <sup>-1</sup>                                       |
| $C_n$      | dead wood/litter stock, under the actual land-use category (after land use occurs), tons C yr <sup>-1</sup>  |
| $A_{on}$   | area undergoing conversion, ha   |
| $T_{on}$   | time period for transition from reference to the actual land use, yr. The Tier 1 default is 20 years for carbon stock increases and 1 year for carbon losses |

Change in carbon stocks in dead organic matter, associated with land conversion depends on the decay rates of DOM pools, which highly differ between regions.

*Decay rates of  
DOM pools*

Tier 1 method assumes that all carbon contained in biomass destroyed during a land-use conversion event is emitted directly to the atmosphere and none is added to dead wood and litter pools. It also assumes that dead wood and litter pool carbon losses occur entirely in the year of the transition. Lastly, litter and dead wood pools are assumed to be zero in all non-forest categories and therefore transitions between non-forest categories involve no carbon stock changes in these two pools. More details for the application of the Tier 1 approach are provided in IPCC 2019 chapter 2. It is highly recommended to follow the detailed application of the IPCC Tiers (as provided in IPCC 2019 chapter 2 and chapter 5, section 5.3.2). The default carbon stock estimates for litter and dead wood (when available) are provided by Table 2.2 of IPCC 2019 chapter 2. Tier 1 methodology only requires the estimates in Table 2.2 for lands converted from Forest Land to any other land-use category.

*Tier 1 method  
assumptions*

Higher Tier estimation methods can be used for non-zero estimates of litter and dead wood pools in agroforestry. The application requires a two-phase approach. During the first phase, there is often an abrupt change in DOM due to land preparation operations (e.g., clearing and burning). The second phase accounts for decay and accumulation processes during a transition period to a new steady-state system. Higher Tier methods may also estimate the details of dead organic matter inputs and outputs associated with the land-use change.

*Higher Tier  
estimation  
methods*

### **Soil Carbon Stock**

The changes in soil carbon stocks include estimates of soil organic C stock changes for mineral soils and CO<sub>2</sub> emissions from organic soils, due to drainage and associated management activities. In addition, C stock change for soil inorganic C pools (e.g., calcareous grasslands that become acidified over time) is included, provided that sufficient information is available (Tier 3). The reference formula is given in Equation 2.24, of IPCC chapter 2 (Tier 1).

*SOC elements*

For mineral soils, the change in soil carbon stock is provided by the difference between soil organic carbon content associated with the reference land use (before land use change) and the one associated with the actual land use (after land use change) (reference formula in Equation 2.25, IPCC chapter 2).

*SOC in mineral  
soils*

The soil organic carbon (SOC) consists of four factors, which depend on climate, soil type, management practice, and C-input practice: the standard soil organic carbon in the 0-30 cm topsoil layer (SOC<sub>ST</sub>), the land use factor (F<sub>LU</sub>), the management factor (F<sub>MG</sub>) and the input factor (F<sub>i</sub>), as specified in the formula below:

*SOC formula*

$$SOC_{mineral_i} = (SOC_{ref} * F_{LU} * F_{MG} * F_I) * A$$

Where:

|                   |  |
|-------------------|--|
| $SOC_{mineral_i}$ | mineral soil organic C stock, associated with land use i (reference or actual) measured as mass of carbon                |
| $SOC_{ref}$       | soil organic C stock for mineral soil in the reference conditions, measured in ton C ha <sup>-1</sup> ,                  |
| $F_{LU}$          | stock change factor for mineral soil organic C land-use systems or sub-systems for a particular land-use, dimensionless, |
| $F_{MG}$          | stock change factor for mineral soil organic C for management regime, dimensionless,                                     |
| $F_I$             | stock change factor for mineral soil organic C for the input of organic amendments, dimensionless,                       |
| $A$               | converted area (is 1 if whole area is subject to conversion).  |

Note that the whole area should have common biophysical conditions.

Reference soil organic C stocks ( $SOC_{REF}$ ) and stock change factors (e.g.,  $F_{LU}$ ,  $F_{MG}$  etc) are based on a 30 cm depth. Table 2.3 of IPCC chapter 2 provides default reference condition soil organic carbon stock values for mineral soils, to be used in Tier 1. Table 5.10, IPCC chapter 5 provides soil stock change factors for land use conversion to cropland to be applied in land-use changes towards coffee cultivation.

*IPCC Tiers*

Tier 2 is an extension of the Tier 1 approach that allows to incorporate country-specific data and to better specifies certain components of the Tier 1 method (e.g., defining country-specific stock change factors or finer disaggregation of default conditions). For the application of Tier 2 the reader should refer to the IPCC chapter 2. Lastly, the approaches in Tier 3 for soil C involve the development of a detailed estimation system based on more advanced models than the methods of Tiers 1 and 2, and/or on the development of a measurement-based data collection with a monitoring network. See section 2.5 (Generic Guidance for Tier 3 methods) of IPCC chapter 2 for additional details on Tier 3 methods.

*Tier 2 approach*

The basic methodology for estimating CO<sub>2</sub> emissions from drainage and management activities of organic soils is to assign an annual emission factor estimating C losses following drainage. Specifically, the area of drained and managed organic soils under each climate type is multiplied by the associated emission factor to derive an estimate of annual CO<sub>2</sub> emissions (source), as presented in Equation 2.26, IPCC chapter 2 (Tier 1). In addition, a specific reference addressing CO<sub>2</sub> emissions from organic soil can be found in the 2013 Wetland Supplement<sup>26</sup> by the IPCC. As for mineral soils, Tier 2 and Tier 3 approaches allow for better specification of certain components of the Tier 1 method.

*Basic methodology*

The Generic decision trees in Figures 2.5 and 2.6 IPCC chapter 2 and Figure 5.6, IPCC chapter 5 support the identification of the appropriate Tier to be used.

*Decision trees*

<sup>26</sup> 2013 Supplement to 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Available at: [https://www.ipcc.ch/site/assets/uploads/2018/03/Wetlands\\_Supplement\\_Entire\\_Report.pdf](https://www.ipcc.ch/site/assets/uploads/2018/03/Wetlands_Supplement_Entire_Report.pdf)

### 3.3.3 Emission Savings from Soil Carbon Accumulation ( $e_{s_{soc}}$ )

Improved agricultural management modifies soil C stocks to varying degrees, depending on how specific practices influence C input and output from the soil system (Paustian et al., 1997a; Bruce et al., 1999; Ogle et al., 2005). The main management practices that affect soil C stocks in Croplands, including perennials like coffee, are the type of residue management, field management practiced, fertilizer management (both mineral fertilizers and organic amendments), choice of varieties, and intensity of cropping management, irrigation management, and mixed systems with cropping and forestry (agroforestry). In addition, drainage and cultivation of organic soils reduce soil C stocks (Armentano and Menges, 1986).

The Carbon Footprint Add-On allows to account for emissions savings due to soil carbon accumulation and carbon removals in soil. The  $e_{s_{soc}}$  element refers to the increase in soil carbon stock which might occur due to improved agricultural management, such as:

- > Improved cropping systems including cover crops, intercropping especially with perennials, agroforestry, and a combination with nitrogen-fixing crops.
- > Improved crop residue management (e.g., leaves, straws, and pruning residues left on the field).
- > Improved fertilizers or manure management (e.g., use of organic fertilizers).
- > Use of soil improver (e.g., compost, manure fermentation digestate).

If a coffee plantation is established on degraded land<sup>27</sup>,  $e_{s_{soc}}$  should be calculated. Respective GHG emission savings should be claimed as a consequence of restored soil fertility and of the increase in soil carbon content.

Emission savings from  $e_{s_{soc}}$  shall be calculated with the same formula described for  $e_i$ , modified as follows:

$e_{s_{soc}}$  formula

$$e_{s_{soc}} \left[ \frac{kg \ CO_2eq}{ton \ coffee \ cherries} \right] = \frac{CS_R \left[ \frac{kg \ C}{ha} \right] - CS_A \left[ \frac{kg \ C}{ha} \right]}{yield \ coffee \ cherries \left[ \frac{ton}{ha \ * \ yr} \right] * n \ [yr]} * 3.664$$

Where:

|               |  |
|---------------|--|
| $e_{s_{soc}}$ | annualized GHG emissions savings from carbon accumulation via improved agricultural management practices,          |
| $CS_R$        | carbon stock associated with the reference crop management practice (i.e. before applying improved management)     |
| $CS_A$        | carbon stock associated with the actual crop management practice (i.e. improved agricultural management in place), |
| 3.664         | conversion factor from C to CO <sub>2</sub>  |
| $n$           | number of years the improved agricultural management is in place (in years),                                       |

<sup>27</sup> Degraded land, according to the United Nations Convention to Combat Desertification (UNCCD) is a land characterized by a reduction or loss "of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical and biological or economic properties of soil; and (iii) long-term loss of natural vegetation".

The result is divided by the yield of coffee cherries and annualized over the period of cultivation (n).

The two following options can be applied for the calculation:

*Options for  $es_{soc}$  calculation*

- > **IPCC methodology**, as defined in the 2006 Guidelines and refined in the “2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories”. The adoption of improved agricultural management practices does not constitute a land use change (chapter 3.3.2). Carbon stock change associated with that, shall be addressed under the IPCC “cropland remaining cropland” only accounting for changes in soil organic carbon<sup>28</sup>. Hence, reference and actual carbon stocks ( $CS_R$  and  $CS_A$ ) are expressed as reference and actual soil organic carbon,  $SOC_R$  and  $SOC_A$  respectively. Therefore,  $CS_i$  and  $SOC_i$  are used synonymously in this chapter.

The application of Tier 2, with country-specific factors, or of Tier 3, when specific factors for coffee varieties are available, is recommended, to duly consider soil specific conditions affecting soil carbon dynamics<sup>29</sup>. For further support on which Tier to apply, the reader can consult IPCC Chapter 2 (Figure 2.5 and 2.6) and Chapter 5 (Figure 2.6).

- > **Field measurements**. Under this option the SOC content and SOC change is measured at farm scale following the recommendations provided in the next chapter.

**General provisions shall be considered for either option applied:**

- > Emission savings from the application of improved agricultural management can be taken into account if evidence is provided that the above-mentioned practices were adopted **after January 2006**.
- > **Solid and verifiable evidence for each individual farm which claims  $es_{soc}$**  shall be provided, showing that soil carbon has increased or that improved agricultural management practices are implemented in best practice so that an increase in soil carbon can be expected over the period in which coffee is cultivated.
- > **The actual values for  $es_{soc}$**  shall be calculated at individual farm level. In case of non-homogenous soil, climate or management practice(s), soil organic carbon values shall be estimated for each single field the farm owns or rents, and  $es_{soc}$  shall be calculated at farm level. This can result in **different  $es_{soc}$  values per farm**.
- > **Increased use of agrochemicals for pest control (e.g., herbicides), due to the application of improved agricultural practices shall be considered** in terms of overall GHG emissions from cultivation. For example, leaving crop residue in the field, without post-harvest incorporation in soil, may significantly increase the risk of spreading plant diseases within the plantation. To avoid such problems, an increase in agro-chemicals input may be required and duly considered in GHG accounting. Additionally, in the case of organic fertilizer use,  $N_2O$  emissions shall be calculated.

<sup>28</sup> In case specific improved agricultural practices imply huge changes in above and below ground, the inclusion of this component might be considered and discussed with 4C

<sup>30</sup> e.g., in Europe sampling based on LUCAS approach and laboratory measurements according to DIN-norms

- > The improved agricultural management practices shall be applied **continuously** for at least three years successively if the BP Producer would like to account for  $es_{soc}$ . This means that it is not allowed to switch management practices every year when  $es_{soc}$  is claimed.
- > When the  $es_{soc}$  improved agricultural management has been applied for three years continuously, the  $es_{soc}$  savings, calculated through the formula described at page 25, can be claimed. Such  $es_{soc}$  value will be valid until a new measurement (i.e., a new  $es_{soc}$  value) is available.
- > If two or more crops are grown in the same field over the same year/agricultural season (i.e., multi-crops system),  $es_{soc}$  savings shall be divided among all crops within the same year/agricultural season. This applies also in case of agroforestry.
- > **Averaging** of emission values from farms applying  $es_{soc}$  and farmers not applying  $es_{soc}$  is **not allowed**, and only those farmers who apply  $es_{soc}$  measures are allowed to forward respective values together with the batch of sustainable material, i.e., green coffee.
- >  $SOC_R$  **shall be monitored and verified** before the improved agriculture management starts. **In absence of that, changes in soil organic carbon (and their magnitude) cannot be detected.**
- > In the case of the IPCC method,  $SOC_R$  and  $SOC_A$  are defined by the standard values. For field measurements, the first field measurement defines  $SOC_R$ , then  $SOC_A$  is measured periodically.
- > In contrast to a direct avoidance of GHG emissions, the increase of SOC as a climate protection measure is only effective if carbon storage is long-term and thus the corresponding amount of  $CO_2$  is removed from the atmosphere for the foreseeable future. Changes in agricultural practices can completely reverse the positive effect of the SOC build-up. Hence, **a long-term commitment from the farmer is required** and adequate proof shall be provided to 4C. 4C reserves the right to reject certain improved agricultural practices if scientific evidence shows that these practices will not sequester the SOC in the long run.

Together with the batch of coffee beans (or coffee cherries if no post-harvest processing took place on farm level), the farmer forwards the actual GHG value for soil carbon accumulation via improved agricultural management  $es_{soc}$  in kg  $CO_2eq/ton$  coffee beans (or coffee cherries) to the next supply chain entity inside the system boundaries.

### 3.3.3.1 Recommendation on Field Measurements

The approach for field measurements of the SOC content shall include the following steps and both sampling and lab analysis shall follow internationally recognized methodologies<sup>30</sup>:

*How to measure*  
 $es_{soc}$

#### 1. Representative sampling method

- a. Sampling is necessary for each plot or field. To simplify measurement procedures, 4C recommends to group fields (from any number of farmers) into Soil/Climate Homogenous Units (SC-Unit). These units could be developed by combining the following two maps:

<sup>30</sup> e.g., in Europe sampling based on LUCAS approach and laboratory measurements according to DIN-norms



- **Soil/Climate Homogeneous Unit (SC-Unit) map of the climate regions.** 4C recommends the use of the IPCC climate region map or any map obtained with a similar methodology,
  - **Map of soil units.** 4C recommends the use of a soil subclasses map, while ensuring homogeneity of soil conditions. An example of an acceptable map is any map produced using the SOTER<sup>31</sup> approach.
  - Farmers may use SOC values from the SC-Unit for fields located within the unit, provided that the same  $es_{soc}$  measure is implemented in all sample pool fields.
- b. At least 1-3 grab samples of 15 well distributed sub samples per five hectares or per SC-Unit, whatever is smaller (considering the heterogeneity of carbon content of the plot) should be taken. The number of grab samples could be increased or decreased in subsequent years based on the heterogeneity of the first SOC measurements.
  - c. Sampling shall be carried out 2 months before or after fertilization and harvesting and only in fields that have already started production.
  - d. Direct measurements of SOC changes in the first 30 cm of the soil.
  - e. The points of the initial sampling to measure  $SOC_R$  under identical field conditions (especially soil moisture) shall be used.
  - f. Sampling protocol shall be documented in a sampling report including identification of the farms, geo-coordinates, timing, sample coding system used and related details.

## 2. Measurement of the SOC content

- a. Soil samples must be dried, sieved, and if necessary, ground.
- b. In case the combustion method is used, inorganic carbon shall be excluded.

## 3. Determination of dry bulk density

- a. Changes of bulk density over time shall be taken into account.
- b. Bulk density should be measured using the tapping method, i.e., by mechanically tapping a cylinder into the soil, which greatly reduces the error associated with bulk density measurement.
- c. If tapping method is not possible, especially in case of sandy soils, another reliable method shall be used instead and documented in the sampling report.
- d. Samples should be oven-dried prior to weighing.

Sampling and lab analysis shall be repeated every two years in the first four years, then every three years after that.

In case this approach is applied, the element  $n$  in the formula for  $es_{soc}$  represents the number of years the improved agricultural management is implemented.  $SOC_A$  ( $CS_A$ ) should be updated with every new measurement.

*Repetition of analysis*

*Updates*

<sup>31</sup> van Engelen, V. W. P., & Wen, T. T. (1992). *The SOTER Manual: Procedures for Small Scale Digital Map and Database Compilation of Soil and Terrain Conditions*, 5th ed. (draft). ISRIC. <https://edepot.wur.nl/29970>

A measurement-based SOC increase curve could be developed to show SOC increase starting from  $e_{s_{soc}}$  measure implementation. This could be used for farmers starting in later years. However, the newly added fields shall be included into the regular measurements to ensure the increase SOC follows the presumed curve within the SC-Unit within reasonable limits.

*SOC increase curve*

### 3.3.4 Emissions from Transport and Distribution ( $e_{td}$ )

Emissions from transport and distribution ( $e_{td}$ ) between BP Producers and BP Service Providers, i.e. post-harvest processing and storage facilities registered in the BPM of the 4C Unit, shall include emissions from the transport of the material (e.g., coffee cherries, green coffee) from the field all the way to the port of export or (local) final destination. In the case of 4C Chain of Custody certification, emissions are included among BP Service Providers registered in the corresponding BPM. The roaster as final processing unit may as well include the downstream transportation, so local distribution of final coffee product to distribution centers or even the end user. Emissions from the transport or commuting of workers do not need to be included.

*Restrictions on the use of  $e_{s_{soc}}$*

*Transport and distribution of coffee*

GHG emissions from transport of coffee cherries, coffee beans or green coffee at any supply chain step can be calculated based on the following formula:

*Upstream*

$$e_{td} \left[ \frac{kg \ CO_2eq}{ton} \right] = \frac{T_{needed} * (d_{loaded}[km] * K_{loaded} \left[ \frac{l}{km} \right] + d_{empty}[km] * K_{empty} \left[ \frac{l}{km} \right]) * EF_{fuel} \left[ \frac{kg \ CO_2eq}{l} \right]}{amount \ transported \ coffee \ in \ transport \ type \ [ton]}$$

Where:

- $T_{needed}$  *transport trips needed,*
- $d_{loaded}$  *transport distance loaded,*
- $d_{empty}$  *transport distance empty,*
- $K_{loaded}$  *fuel usage loaded,*
- $K_{empty}$  *fuel usage empty*

In order to find out how often a transport type was used for the transported amount,  $T_{needed}$  shall be calculated. If, e.g., amount is received in ton, this value is calculated by dividing the amount of transported goods by the loading weight of the transport system used, e.g., if 100 tons of input material is transported by trucks which can carry 20 tons, 5 trucks ( $T_{needed} = 5$ ) would be needed to transport all the coffee beans or green coffee. The sum of the fuel consumption of loaded transport and empty transport (if applicable) is multiplied with the number of times this transport system is being used and the emission factor of the fuel.

*Transport type and trips*

As an alternative, the methodology for ton-km may also be used. This formula is especially relevant for ship and train transport and distribution, where no empty return transport has to be considered:

*Ship and train transport*

$$e_{td} \left[ \frac{kg \ CO_2eq}{ton} \right] = \frac{(amount_{coffee \ in \ transport \ type} [ton] * distance_{transported} [km]) * EF_{transport \ type} \left[ \frac{kg \ CO_2eq}{tkm} \right]}{amount \ transported \ coffee \ in \ transport \ type \ [ton]}$$

The amount of transported coffee cherries, coffee beans or green coffee is multiplied by the total distance and by an emission factor in ton-km for the transport type. This approach needs to be repeated for each amount of material transferred via a different transport type. If all the material is transported via only one transport type, this calculation only needs to be done once.

For the calculation of  $e_{td}$ , the necessary information and data need to be provided through on-site data gathering. All input values shall be obtained for the same time period.

The responsibility of calculating transport emissions per supply chain step is as follows:

- Farm is not responsible for transport calculations
- Intermediate entity between farm and dry mill is responsible for upstream transport of coffee cherries from farm level
- Dry mill is responsible for upstream transport from previous entity (e.g. farm or intermediate) AND if last entity of 4C unit system boundary is also responsible for downstream transport to next intermediary buyer OR if there is no intermediary buyer within the supply chain up to the port of export or local destination
- Intermediary buyer is responsible for upstream transport from previous entity (e.g. dry mill or other intermediary buyer) if not receiving respective values together with green coffee beans delivery from previous entity
- In general, roaster as final processing unit is responsible for upstream (international) transport from country of origin to roasting site. However, exceptions can change the responsibility for accounting for transport emissions. Further downstream transport by the roaster e.g. to a distribution center or final consumer can be included on a voluntary base.

The following figures (Figure 8, Figure 9) show examples of which supply chain entity is responsible for calculating transport and distribution emissions in the coffee supply chain:



Figure 8: Example dry mill up- and downstream transportation emissions

Emission factor  
in ton-km

Data gathering  
requirements

Transport  
emissions  
responsibility

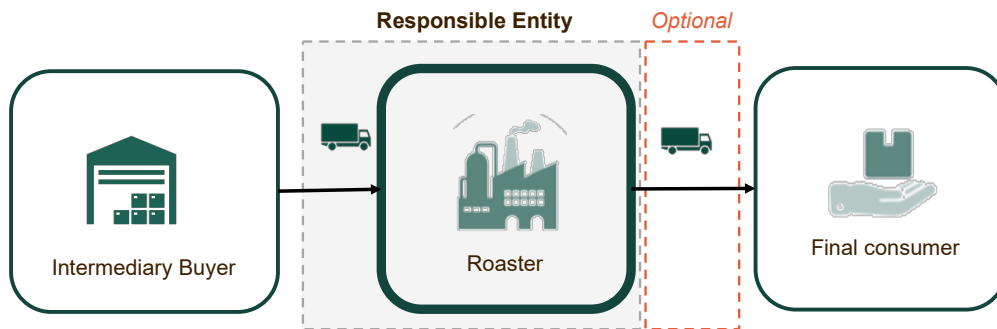


Figure 9: Example roaster upstream transportation emissions

Together with the batch of coffee cherries, beans or green coffee the supplier forwards the actual GHG value for transport  $e_{td}$  in kg CO<sub>2</sub>eq/ton coffee beans or respective output to the recipient.

### 3.3.5 Emissions from Processing ( $e_p$ )

Emissions from processing are emissions generated by the BP Producers if post-harvest processing takes place on farm level and BP Service Providers, i.e., post-harvest processing facilities are registered in the BPM of the 4C Unit. In the case of 4C Chain of Custody certification, this applies to post-harvest processing facilities registered in the corresponding BPM (e.g. post-harvest processing facilities used by traders, roasting plants used by the brand owners).

Coffee roasters shall also calculate processing and transport emissions following the methodology described in chapters 3.3.4 and 3.3.5. As the final processing unit, they shall also consider the information in chapters 3.3.6 and 3.3.7.

Emissions from processing,  $e_p$ , shall include emissions from the processing itself (washing, hulling, grading, packing), from waste and leakages and from the production of additives or products used in processing, including the CO<sub>2</sub> emissions corresponding to the carbon content of fossil inputs, whether or not actually combusted in the process. Emissions from processing shall include emissions from drying of co-products and materials where relevant. Emissions from the manufacture of machinery and equipment are not required to be taken into account, since they are not directly connected to the coffee cultivation or production process.

The calculation shall be based on the following formula:

$$e_p \left[ \frac{\text{kg CO}_2\text{eq}}{\text{ton}} \right] = \frac{(EM_{\text{electricity}} + EM_{\text{heat}} + EM_{\text{inputs}} + EM_{\text{wastewater}}) \left[ \frac{\text{kg CO}_2\text{eq}}{\text{yr}} \right]}{\text{processed coffee beans or green coffee} \left[ \frac{\text{ton}}{\text{yr}} \right]}$$

The emissions of the different inputs (EM) shall be calculated according to the formulas below and divided by the yield of coffee beans or green coffee depending on the processing stage.

Formula components for calculating EM are:

$$EM_{\text{electricity}} = \text{electricity consumption} \left[ \frac{\text{kWh}}{\text{yr}} \right] * EF_{\text{regional electricity mix}} \left[ \frac{\text{kg CO}_2\text{eq}}{\text{kWh}} \right]$$

Calculating  
processing  
emissions

Roaster

Emission  
sources to be  
covered

Calculation  
formula

Emissions of  
different inputs

Energy  
emissions

## Electricity

If electricity is sourced externally from the grid, the emission factor for electricity from the regional electricity mix shall be used (average emission intensity for a defined region,  $EF_{\text{regional electricity mix}}$ ). If electricity from renewable energies is directly consumed (i.e., not supplied from the grid), an adapted EF for the type of renewable electricity may be used if that plant is not connected to the electricity grid. If renewable electricity is purchased from an external provider via guarantees of origin (GoO) or power purchase agreement (PPA), the respective EF provided for this electricity (mix) can be used as an alternative. The GoO or PPA shall be made available for audit purposes.

Emissions from office activities are not required to be taken into account.

## Office activities

For calculating the emissions from heat production, two different formulas can be used, based on the available units of the provided heat:

## Heat

$$EM_{\text{heat}} = \text{fuel consumption} \left[ \frac{\text{kg or l}}{\text{yr}} \right] * EF_{\text{fuel/heat system}} \left[ \frac{\text{kg CO}_2\text{eq}}{\text{kg or l}} \right]$$

or

$$EM_{\text{heat}} = \text{heat produced from fuel} \left[ \frac{\text{MJ}}{\text{yr}} \right] * EF_{\text{fuel/heat system}} \left[ \frac{\text{kg CO}_2\text{eq}}{\text{MJ}} \right]$$

As the emission factors for heat production differ for the fuel and the heating system, both data shall be documented. For calculating  $EM_{\text{heat}}$  the consumed heat or the fuel consumption for producing the heat for all activities during processing shall be determined and multiplied with the respective emission factor. If coffee husks or other residues from coffee cultivation, e.g., wood from pruning or renovation of the coffee plantation, are used for heat production on the farm or processing unit, upstream emissions can be set as zero. Biogenic  $\text{CO}_2$  emissions from burning can be excluded from the calculation. However, resulting  $\text{N}_2\text{O}$  and  $\text{CH}_4$  emissions shall be accounted for and included in the GHG calculation. IPCC provides separate emission values per greenhouse gas that can be used to differentiate the emissions occurring from biomass burning<sup>32</sup>. The values per greenhouse gas need to be converted into  $\text{CO}_2$  equivalent values by multiplying with the respective GWP and both can be found in the Annex of this document.

## Emission factors for heat production

If such material for heating purposes is coming from an external source, respective upstream emissions shall be accounted for in the calculation and reflected in the respective emission factor. The respective data and information shall be documented in the calculator. Biogenic  $\text{CO}_2$  emissions have to be documented as well but separately from the GHG calculation for example as an extra table next to the GHG results overview.

$$EM_{\text{inputs}} = \text{inputs consumption} \left[ \frac{\text{kg or l}}{\text{yr}} \right] * EF_{\text{inputs}} \left[ \frac{\text{kg CO}_2\text{eq}}{\text{kg or l}} \right]$$

## Other inputs emissions

$EM_{\text{inputs}}$  refers to all other types of inputs required as e.g., additives, fresh/process water, diesel or other fuel used in the production process (e.g., natural gas).

<sup>32</sup> IPCC 2006 Guidelines for National Greenhouse Gas Inventories, <http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html>

$$EM_{wastewater} = wastewater \left[ \frac{cbm}{yr} \right] * EF_{wastewater} \left[ \frac{kg CO_2eq}{cbm} \right]$$

*Wastewater emissions*

All wastewater that is generated during the activities of processing shall be documented and multiplied with the respective emission factor.

Every processing unit in the supply chain shall ensure that all GHG emissions from processing, GHG emissions from wastes and from process-specific inputs are included in the emissions calculation.

*Inclusion of all emissions*

For the calculation of GHG emissions from processing ( $e_p$ ), the following data shall be determined as a minimum, i.e., the respective quantities shall be extracted from respective operating documents and must be verified by the auditors. The following data for the calculation of GHG emissions shall be gathered on-site. All input values shall be gathered for the same time period.

*Minimum requirements*

- > Amount of main product in tons per year converted to coffee beans or green coffee
- > Amount of process-specific inputs used (e.g., chemicals, process water, diesel or other fuel, packaging material) in kg per year or liters per year
- > Electricity consumption in kWh/yr and source of electricity (e.g., grid)
- > Heat consumption in MJ/yr, fuel or energy source for heat production (e.g., natural gas, wood) and type of heating system (e.g., boiler)
- > Amount of waste (e.g., leaves, husks, shells, pulp) in kg per year and wastewater in m<sup>3</sup>/yr

When calculating emissions from wet processing of coffee or intermediate products, potential methane emissions from wastewater treatment and pulp decomposing shall be considered and calculated as well. Normally, methane emissions could occur during wet processing of coffee or intermediate products when the cherry beans are de-pulped with or without mucilage and/or hulled before drying.

*Methane emissions*

If the calculation is conducted for a sample of BP processors, the GHG value for processing emissions can be averaged following the same approach as for farm samples in 3.2.1.

### 3.3.6 Forwarding GHG Emission Values in the Supply Chain

GHG values shall be forwarded along the supply chain according to the physical flow of the coffee.

*Forwarding of GHG values*

Each entity in the supply chain belonging to the defined system boundary (see chapter 3.1) shall forward the individually calculated GHG emission value of their production process together with the amount of coffee to the next downstream entity. For example, a 4C Unit shall calculate the emissions of the coffee produced and processed within its facilities, as detailed in the previous chapters, and declare those values when forwarding the coffee to the next entity in the supply chain, for instance, an intermediary buyer.

The 4C Portal has a feature where the 4C Units and Chain of Custody members can insert the correspondent emission values of each stage:  $e_c$ ,  $e_p$ ,  $e_t$ ,  $e_{s_{soc}}$ ,  $e_{td}$ . For some GHG values, like processing emissions or transport emissions, actual values need to be added at each step of the chain of custody by the respective operational unit.

*4C Portal*

4C will provide a calculator with standard values for different modes of transport as a reference, that intermediary and final buyers can adopt. If companies already have more efficient logistics or have implemented reduction measures, it will be possible to insert their actual emissions, which will be verified during the audit.

*Transport default values*

The GHG emission value shall be forwarded in the correct unit of kg CO<sub>2</sub>eq/t coffee beans or respective output to the recipient. For the final processing unit in level 2 of the certification, e.g., the dry mill, the respective unit shall be kg CO<sub>2</sub>eq/t green coffee. For further information on producers of final coffee products please see chapter 3.3.7.

*GHG unit*

Incoming GHG emission values need to be adjusted from kg CO<sub>2</sub>eq/t coffee cherries to kg CO<sub>2</sub>eq/ton coffee beans and from coffee beans to green coffee. In order to do so, total emissions of incoming coffee beans are multiplied by a **feedstock factor (FF)**. The feedstock factor can be defined as the ratio between the total amount (mass) of feedstock and the total amount (mass) of produced main output. It shall be applied for all incoming emissions ( $e_c$ ,  $e_{S_{SO}C}$ ,  $e_i$ ,  $e_p$ ,  $e_{id}$ ) as they are expressed in terms of the feedstock and need to be converted to the respective outgoing product of the unit calculating emissions. The following formula shall be applied:

*Feedstock factor application*

$$\text{Feedstock Factor (FF)} = \frac{\text{Total amount (mass) of feedstock}}{\text{Total amount (mass) of produced main output}}$$

The calculation and application of this FF is mandatory to carry over the emissions of feedstock to the produced main output. The formula below shows an example how the feedstock factor shall be applied when a wet mill has received a GHG value for emissions from cultivation for coffee cherries as feedstock for its processing activities.

*Conversion of upstream emissions*

$$\text{Emissions coffee beans (ec)} \left[ \frac{\text{kg CO}_2\text{eq}}{\text{ton coffee beans}} \right] = \text{Emissions for cultivation of coffee cherries (ec)} \left[ \frac{\text{kg CO}_2\text{eq}}{\text{ton coffee cherries}} \right] * FF$$

Within the coffee supply chain from farm to dry mill, the input products vary from coffee cherry to dry green coffee, with coffee beans as an additional intermediate main product for intermediate processes e.g. at a wet mill or washing station. In this situation, FF shall be calculated twice:

*FF for different coffee products*

1. FF for the conversion of coffee cherry to coffee beans (farm to wet mill)
2. FF for the conversion of coffee beans to green coffee (wet mill to dry mill)

The following figures (Figure 1010, Figure 1111, Figure 1212) illustrate some examples of post-harvest processing and physical flows of coffee along the supply chain. This same rationale shall be applied on a case-by-case basis, according to the specifics of the supply chains registered within each 4C Unit.

*Forwarding GHG emissions*

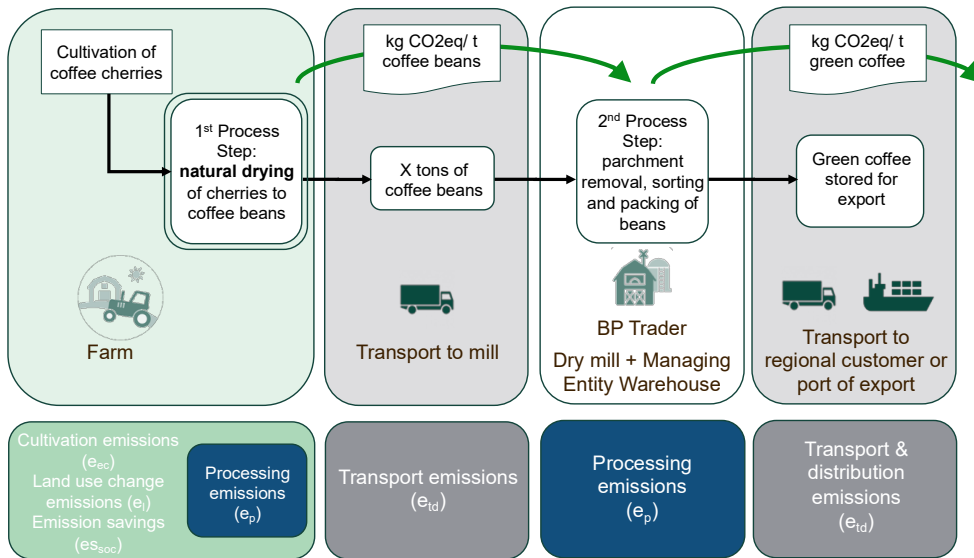


Figure 10: Example of natural coffee - dry processing done on the farm

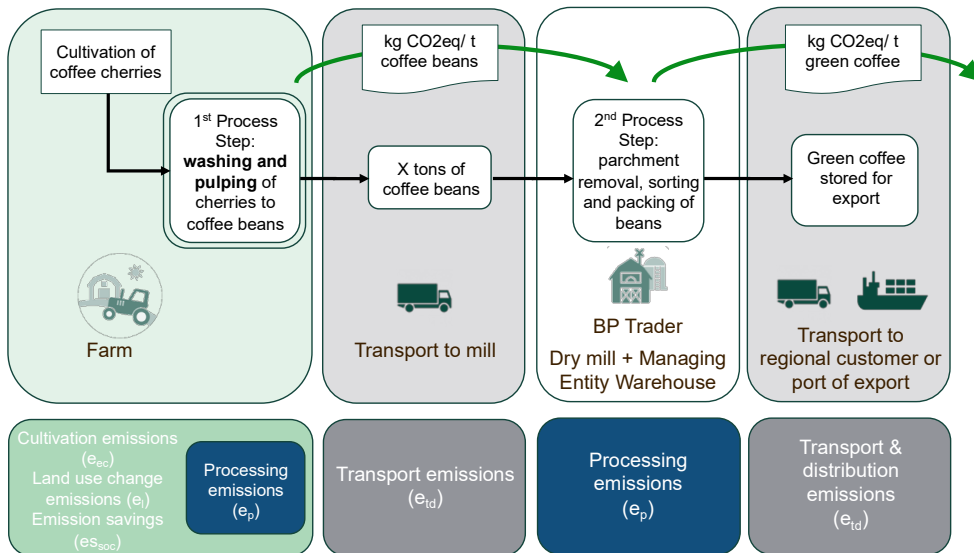


Figure 11: Example of washed coffee - wet processing done on the farm

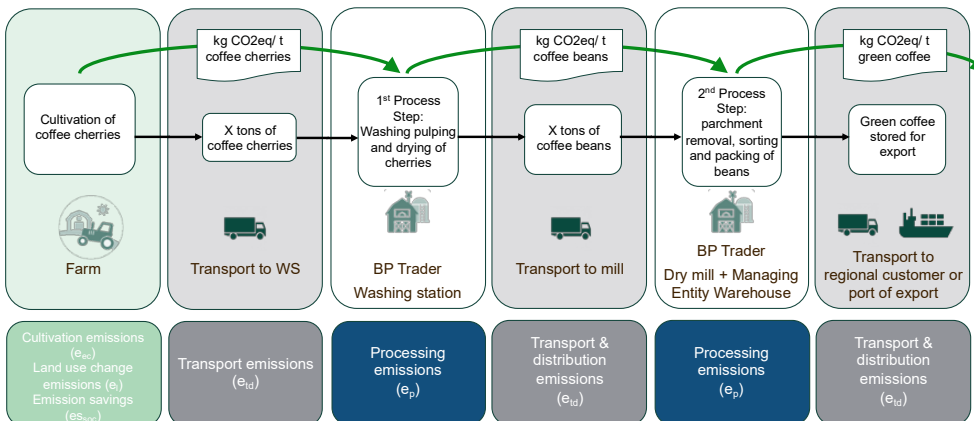


Figure 12: Example of washed coffee - wet processing in central station



### 3.3.7 Further Requirements for Producers of Final Coffee Products

If GHG emissions shall also be calculated for downstream processing activities after dry mill and international transport i.e. warehousing and roasting, the calculation shall follow the same rules as for the upstream production process described in chapters 3.3.4. and 3.3.5.

Formula elements which shall be covered are

- emissions from *processing*  $e_p$   
and
- emissions from *transport and distribution*  $e_{td}$ .

GHG emissions from all *upstream activities* (incl. cultivation, pre-processing, national transport) shall be included by using the GHG emission value forwarded together with the amount of green coffee as incoming value from the last upstream entity.

The next entity in the supply chain e.g. the roaster receiving green coffee has to account for the emissions from these (international) transportation activities from point of export to the gate of the respective facility. Each processing unit shall account for its upstream transport emissions. The roaster as final processing unit may as well include the downstream transportation, so local distribution of final coffee product to distribution centers or even the end user. The final entity in the supply chain can also voluntarily include downstream warehouses that are not belonging to the processing site.

Roaster GHG  
emissions

Upstream GHG  
emissions

Roaster  
Downstream  
emissions

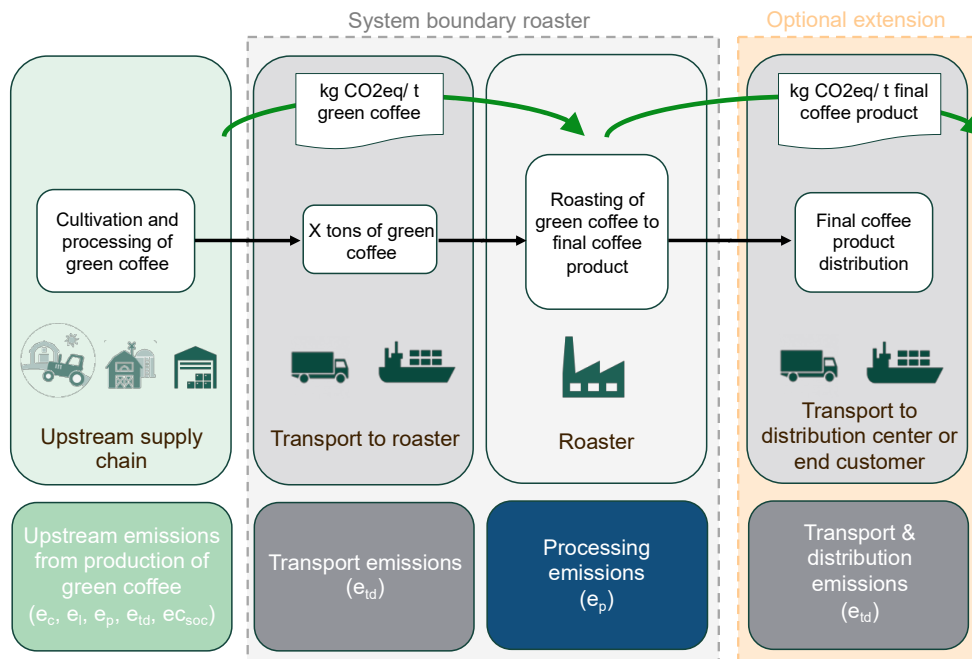


Figure 13: System boundaries for a roaster

The forwarding process should follow the same rules as for all previous supply chain steps described in chapter 3.3.6. The producer of a final coffee product as well has to apply the FF to convert the incoming GHG emission value into the respective final unit of the coffee product e.g., roasted coffee beans. Figure 13 gives an overview of the calculation and forwarding activities for roasters as final unit.

## 4 Improvement Plan to Reduce GHG Emissions

At Level 3 of the certification, when emission reduction or maintenance actions (for IB/FB) are aimed, an improvement plan (IP\_CF) shall be developed and implemented that demonstrates how emission management will be achieved. The initial GHG calculation for the coffee supply can be used and analyzed with respect to the identification of the most relevant emission sources. The effectiveness of the measures should be demonstrated by a GHG emission reduction that can be attributed to the respective measure within one year after the baseline GHG calculation was conducted. The measures can include one or multiple parts of the supply chain.

*Setting up  
improvements*

Final reduction or maintenance (for IB/FB) of emissions needs to be presented at the end of the certification period, reflecting improvement activities from all parts of the certified unit. It is possible that e.g. at farm level there is an increase of emissions due to a measure but a decrease at wet mill level due to another measure as long as the final GHG value for the certified unit is decreased, the certification is valid.

### 4.1 Elements of the Improvement Plan

The objective of the IP\_CF is to provide sufficient information regarding the GHG emission reduction and maintenance (for IB/FB) activities, planned or already implemented, in the coffee supply chain. The timeframe for the implementation of certain measures depends on type and scope and should be documented. The development, update, and submission to the CBs of the IP\_CF regarding GHG emissions reduction and maintenance (for IB/FB) measures shall follow the requirements and steps described in chapter 4.3.3 of the 4C System Regulations for certified 4C Units. The certification under the Carbon Footprint Add-On requires the completion and update of an improvement plan, a separate applicable template is available and named IP\_CF. For this document, the following points shall be included along with any additional information and documentation that is considered to be of relevance.

*Improvement  
Plan  
requirements*

#### 4.1.1 Baseline

- a) **Base year definition:** A specific year to which future GHG emissions are to be compared to in order to monitor the emission reductions achieved. The base year shall be the initial year for which GHG emissions were calculated under the 4C Carbon Footprint Add-On. An earlier base year can be accepted if it was set according to the guidelines from the Science Based Targets initiative.
- b) **Base year GHG emissions:** Summary of GHG emissions in the selected base year including the final value for GHG emissions in kg CO<sub>2</sub>eq/t green coffee.
- c) **Baseline scenario:** Information on the projected emissions in a scenario with no emission reduction measures. The projections need to be fully described and include the report on data sources, emission factors and assumptions.

*GHG  
emission  
baseline*

#### 4.1.2 GHG Emission Reduction Targets

- d) **Emission reduction target definition:** The IP\_CF for the 4C Unit (including proposed measures and/or report of emission reduction at BP Producers and Processors and any involved transportation activities managed by Managing Entity) needs to include at least a total emission reduction target for the whole certification period (meaning the whole validity period of the CF certificate issued), preferable interpreted in a specific annual reduction target, based on the calculated GHG emissions of the defined baseline year. This reduction target can be set by the Managing Entities depending on the baseline scenarios and practical feasibility. The 4C Carbon Footprint Add-on is flexible in terms of reaching an annual reduction target for entities as long as the emissions occurring from green coffee production are reduced. An increase of the carbon footprint at any stage in the production process and during the certification period is not allowed. This is corresponding to the ambition level of the annual linear reduction rate according to the near as well as long-term temperature goal of below 1.5°C.<sup>33</sup> These targets can be set according to any commercial projections or sustainability strategies the company may have, or previous commitments with the SBTi. As the SBTi clearly highlights reduction requirements vary dependent on sector-specific and commodity specific pathways, the minimum reduction target according to 4C CF Add-On are well adhered to coffee sector as well as practical reductions envisaged based on research and practical experience.

The IP\_CF is also mandatory to all 4C CF Add-On certificate holders, Intermediary and Final Buyers. However, in comparison to BP producers and processors an emission reduction is voluntary. A flexible target can be made as long as the level of emissions is maintained and feasible measures are applied and monitored regularly. The respective measures have to be documented in the IP\_CF for verification during the Annual Updates of CF and CF audit. Therefore, IB and FB also commit to not increase GHG emissions in the production of a final coffee product.

- e) **Emission reduction target timeframe:** For every target presented in the IP\_CF, a specific deadline should be defined. This deadline can be set in a short-, mid-, or long-term timeline and need to be monitored and further reported with subsequent recertifications.
- f) **Emission reduction verification:** The achieved GHG emission reductions for BP producers and Processors and/or transportation of a 4C Unit, as well as the at least maintenance of the carbon footprint of the final coffee product for IB and FB are verified by the CB and validated by 4C during the CF audits and Annual Update of CF.

#### 4.1.3 GHG Emission Reduction Measures

- g) **Reduction measures description:** Brief report of the activities included in the emission reduction measure. This description needs to include specific information on the size of the project, location, technology requirements, parties involved in the implementation and planned operation starting date.

<sup>33</sup> Science Based Targets initiative. Target Validation Protocol. TWG-PRO-002 | version 2. April 2020. Table 3. Minimum ambition thresholds

- h) **GHG emission reduction potential:** Information on the projected emissions avoided through the implementation of the measure. The projections need to be fully described and include the report on data sources, emission factors and assumptions.
- i) **Co-benefits:** If applicable, mention all additional rewards or secondary effects resulting from the implementation of the emission reduction measure. These can include additional improvements in areas such as energy security, climate change adaptation, poverty reduction, gender equality, among other social benefits.

#### 4.1.4 Monitoring Plan

- j) **Plan description:** Overall description of the monitoring activities to keep track of the progress of each of the emission reduction measures. This section needs to include monitoring procedures, involved parties in the monitoring process, and data collection systems used.
- k) **Description of types of data and information reported:** Full list of which data will be collected for monitoring purposes. The type of data will depend on the characteristics of the measure and shall represent a key indicator of the performance of the reduction measure. Examples of these indicators are monthly electricity consumption (kWh/month), weekly water consumption (m<sup>3</sup>/week), fertilizer consumption (kg/month), etc.
- l) **Data quality:** Clarification of all data sources where information for the defined indicators is to be collected. This section shall indicate if assumptions and estimations have been made, as well as provide any supporting information sources for default values or proxy data. If there are any data gaps present, information needs to be provided on how they have been addressed.
- m) **Reporting methodology:** It is also necessary to include a description on how the reporting will be done, including information about the responsible party and data management. This includes a clarification if the reporting will be made through on-site surveys, self-reporting on paper, digital tools or mobile applications; as well as who will be collecting/storing the final data.
- n) **Monitoring timeline:** A clear timeline needs to be presented on the frequency and planned dates for data reporting deadlines. Data reporting can be done in different frequencies depending on the characteristics of each measure, but a total amount for 12 months should be collected as part of the monitoring activities for the Carbon Footprint Add-On certification.

*Monitoring  
emission  
reductions*

## 4.2 GHG Emission Reduction and Carbon Removal Measures

As part of the IP\_CF, information on currently implemented GHG emission reduction measures should be included. Emission reduction measures can be implemented in any element of the supply chain. Measures focused on soil carbon accumulation in coffee are included in the examples provided in Annex II. The emission reduction measures can include measures from cultivation, processing, transport, distribution, roasting, and final packaging stages. Some of the measures include but are not limited to, the reduction of fertilizer and pesticides, soil organic carbon accumulation, use of renewable energy in processing, use of energy-efficient machinery, logistic management, packaging, etc. Detailed examples of measures are listed in **Annex II**.

*Emission reduction examples*

## 5 Carbon Footprint Add-On Certification Process

The audit and certification process for the core 4C certification as described in chapters 5, 6, and 7 of the 4C System Regulations shall be carried out for the Carbon Footprint Add-On certification. The term Carbon Footprint Add-On certification applies to the 4 implementation levels, as listed below.

*Options for system users*

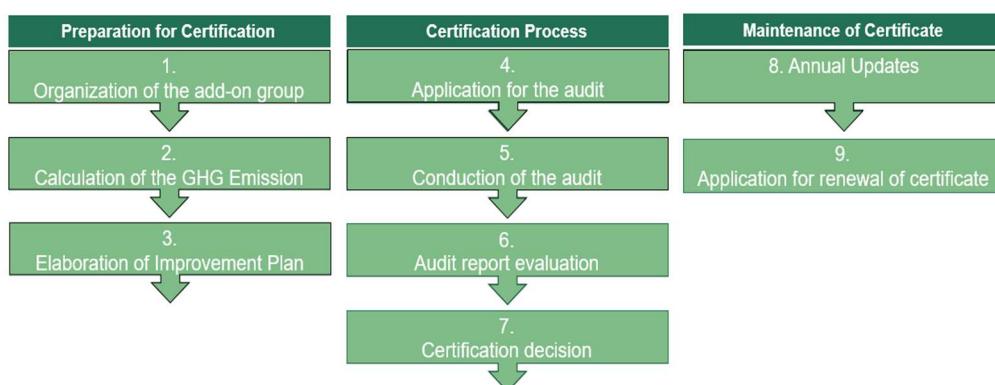
- **Level 1:** GHG emissions calculation at the 4C Unit level
- **Level 2:** GHG emissions calculation at the 4C Unit level and Intermediary Buyers, or optional also Final Buyers
- **Level 3:** level 1 or 2 including the reduction of the GHG emissions
- **Level 4:** level 3 including carbon compensation

*CF Add-on levels*

Therefore, the auditing and certification procedures described in the following chapters should be applied for any of the implementation levels mentioned above. All 4C System Updates should also be considered as a general requirement relevant to the audit and certification process.

The complete certification process of the Carbon Footprint Add-on comprises three different steps: preparation for certification, certification process and maintenance of the certificate. The steps are detailed in the picture below:

*Complete certification process*



*Figure 14: Complete Certification process of the Carbon Footprint Add-On*

4C CF Add-On certificate is valid for three years with successful Annual Updates and compliance with the 4C CF Add-On requirements<sup>34</sup>.

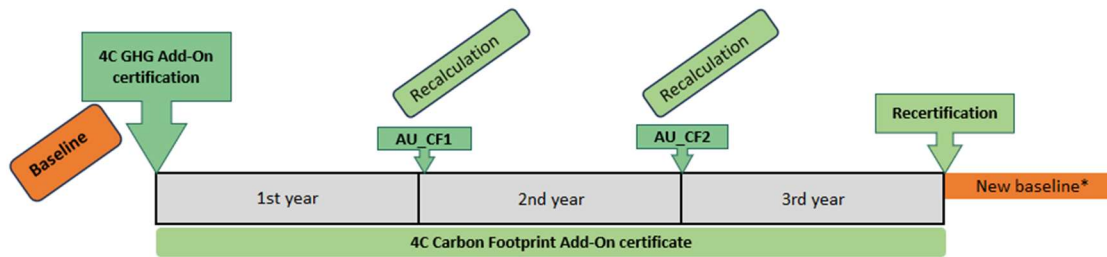


Figure 155: A complete cycle of 4C CF Add-On certification

## 5.1 Preparation for Certification

The first step to apply for the 4C Carbon Footprint Add-On is to organize the group that will apply the Add-On. The core 4C certification is a pre-requisite for the Add-On, and the Managing Entity can decide if it wants to pursue the Carbon Footprint Add-On certification for a whole 4C Unit or for a sub-unit of the 4C Unit. The BPM of the core 4C certification will have an extra column where it will be possible to signal which BPs are under the Add-On.

*Organizing the Add-On group for 4C Units*

To add new BPs in an existing 4C Unit certified under the Carbon Footprint Add-On, the MEs need to calculate the footprint of the new BPs before including them in the Unit. The ME needs to observe that including new BPs could increase their carbon footprint, instead of reducing it. That is why it is recommended to only include new BPs that are already working on reducing their emissions. It is also important to note that the resulting CF Improvement Plan needs to be cumulative and that 4C has the right to request detailed information about the added BPs, including to which sub-group they will belong.

*Adding new BPs to the CF 4C Unit*

To remove BPs from an existing CF 4C Unit, MEs also need to observe that, between certification audits, when performing the Annual Updates 1 and 2, the baseline will not change, and the monitoring of progress will consider as if the removed BPs are still there. In the recertification audit, it will be possible to create a new baseline, removing the BPs that have left. In this case, 4C also has the right to request detailed information about the BPs that left the Unit or sub-unit, including to which sub-group they belonged.

*Removing BPs from the CF 4C Unit*

In the case of Chain of Custody (CoC), the core 4C CoC certification is also a pre-requisite and the formation of sub-groups is not possible, meaning that all facilities need to be considered as part of the Add-On. If a certain Intermediary or Final Buyer is only trading and storing coffee, not performing any processing activities, then they should only add transport and distribution emissions and forward the sum to the next supply chain entity. In case processing is involved in their scope, they also need to include the respective processing emissions.

*Organizing the Add-on group for CoC*

<sup>34</sup> New baseline must be conducted in case of restructuring of 4C units (inclusion or exclusion of BPs).

While still in the preparation phase of the certification process, it is necessary to calculate the GHG emissions according to the methodology described in the previous chapters. In addition to that, for the 4C users interested in getting the certification on levels 2 and 3, it is necessary to elaborate the improvement plan before applying for the certification.

*Additional documents for preparation phase*

## 5.2 Certification Process

In addition to the procedures and requirements described in chapters 5.2.2, 5.2.3 and 5.2.4 of the core 4C System Regulations, all requirements listed in this section shall be met.

The scope of the Add-On audit is focused on coffee cultivation areas. Therefore, it does not apply to other crops and land uses that may eventually occur on the same farm as required by the core 4C certification.

*Add-On scope*

Apart from the documentation that shall be available for the core 4C certification audit, there shall also be documentation available related to the calculation of GHG emissions and other documents used to support the elaboration of the Improvement Plan to reduce the GHG emissions. The same rule applies to documentation related to carbon offsetting. This means that the data, records, reports, scientific articles, procedures and other related documents as detailed in chapters 3 and 4 of this document must be available for verification during the audit. This rule applies to all 4 implementation levels.

*Documents for audit*

The list of CBs cooperating with 4C and authorized to conduct the Carbon Footprint Add-On audit is available on the 4C website. Currently 4C accredited CBs and its auditors need to participate on the Carbon Footprint Add-On training to be approved for this scope. There are no further requirements.

*Conditions for CBs and auditors*

### 5.2.1 Audit Types

The following audits can be conducted by the CB:

**Add-On certification audit:** during the certification audit, the necessary evidence is gathered to verify compliance with the requirements described in this document and future system updates which support the Carbon Footprint Add-On certification decision. The first certification audit is called initial Add-On audit and the following audits to be conducted with the purpose of renewing the Carbon Footprint Add-On certifications are called recertification Add-On audits.

*Add-On certification audit*

The Add-On certification audits can be combined with the core 4C certification audits, i.e., the CB can conduct both audits simultaneously provided that the requirements for both audits are met.

Therefore, in the case of 4C certification for producing groups (4C Units) there are four options for the initial Add-On audit as follows:

*Audit combination*

- (1) Combined with the core 4C certification audit during the harvest season.
- (2) Combined with the core 4C initial certification audit during the off-harvest season, according to the exception rule described in chapter 6 of the 4C System Regulations.
- (3) Combined with the core 4C surveillance audit (if required based on 4C core certification).
- (4) Independent from other types of 4C audits, i.e., on another date. But always after an initial core 4C certification audit.

It is not possible to conduct Add-On certification audits combined with the core 4C addendum audit due to the impossibility of matching the sampling rules for both scopes.

*Combination with addendum*

The recertification Add-On audits can be combined with the 4C core certification audits aiming to renew both certifications at the same time. The updated GHG calculation as described in this document and the updated IP\_CF describing the reduction measures shall be available before submitting an application for the 4C Climate Friendly Coffee recertification audit.

*Re-certification audits*

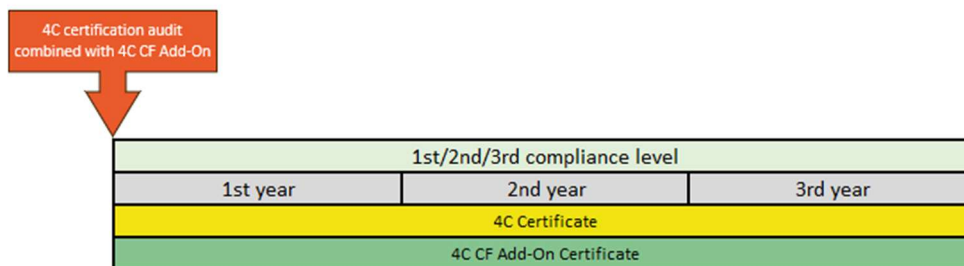
In case there is the need to conduct a recertification Add-On audit independent from the core 4C certification audit, the issuance of the Carbon Footprint Add-On amendment is conditioned to the core 4C certification decision.

*Independent audits*

For 4C Chain of Custody certification there are three options for the initial Add-On audit as follows:

*CoC Add-On audit*

- (1) Combined with the core 4C certification audit
- (2) Combined with the core 4C surveillance audit (which mandatory every year for CoC)
- (3) Independent from other types of 4C audits, i.e., on another date. But always after an initial core 4C certification audit.



*Examples of audit combination*

Figure 16: Add-On audit combined with core 4C certification audit

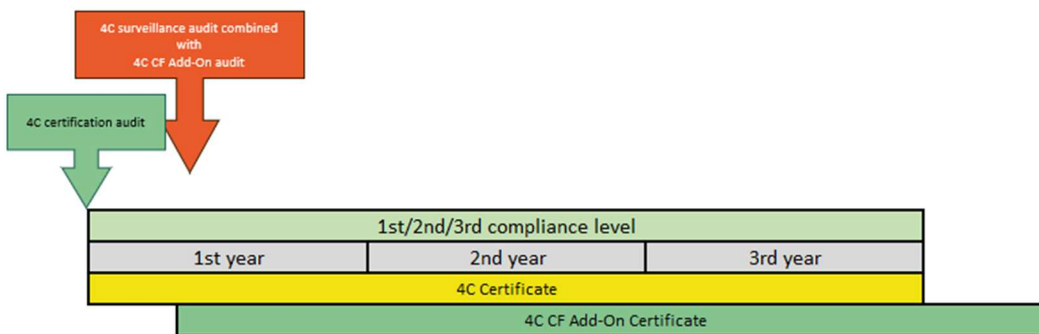


Figure 17: Add-On audit combined with 4C surveillance audit



## 5.2.2 Application for Carbon Footprint Add-On Audit

The procedures and requirements described in the core 4C System Regulations<sup>35</sup> shall be observed as they provide detailed rules on how to apply and plan the 4C audit for the core 4C certification. In general terms, the CB shall register an audit application in the 4C Portal, which needs to be validated by 4C. If the audit is an initial one, the CB and the ME will also receive a unique registration number for the ME. To prepare for the audit, the CB shall perform a risk assessment using GRAS ([Global Risk Assessment Services](#)) and other tools and register audit plan with information required through the 4C Portal, including dates, times, activities, duration, locations, risk levels, sample size and other relevant information. We recommend the readers of this guide to go through the 4C Systems Regulations document if they are not already familiar with the 4C System requirements.

*Core 4C certification procedures apply*

In addition to the 4C System Requirements, the following requirements shall be complied with for a Carbon Footprint Add-on audit:

*Additional requirements*

The baseline GHG calculation conducted according to the requirements described in this document shall be available before submitting an application for the Carbon Footprint Add-On certification. The same procedure applies for the improvement plan when the implementation levels 3 and 4 are adopted, as these levels include the emission reduction measures.

Only CBs cooperating with 4C and being approved to conduct the Carbon Footprint Add-On audits and certification process shall conduct respective audits.

*Certification Bodies*

The application documents must be filled in by the applicant and sent to the selected CB. The table below summarizes the corresponding application documents:

*Application documents*

*Table 2: Application documents*

| Level   | Scope               | Type of certificate                      | Type of documents needed                    |
|---------|---------------------|--|---|
| Level 1 | 4C Unit             | Verification of Carbon Footprint         | BPM+ Calculations                           |
| Level 2 | 4C Unit + IBs + FBs | Verification of Carbon Footprint         | BPM + Calculations                          |
| Level 3 | 4C Unit + IBs + FBs | Certification of Climate Friendly Coffee | BPM + Calculations + IP_CF                  |
| Level 4 | 4C Unit + IBs + FBs | Certification of Climate Neutral Coffee  | BPM + Calculations + IP_CF + Carbon Credits |

The GHG emissions calculation report shall be delivered as an Excel file, in open format (not protected). All production steps and formula elements should be separated and clearly displayed. The final GHG emission value and important information on the calculation should be summarized and displayed in an overview sheet in the Excel file. Calculations should be directly connected to respective data cells in the file to ensure transparency and traceability in the audit.

*Format of the calculation report*

The information provided through these documents will be checked by the CB before conducting the next steps, i.e., risk assessment, preparation and registration of the audit plan on the 4C Portal as described for the core 4C certification.

*Next steps*

<sup>35</sup> For more detailed information please refer to chapters 5.2.1 and 6.4 of the 4C System Regulations.

### 5.2.3 Risk Assessment, Sample Size Calculation and Selection

In addition to the procedures and requirements described in chapter 5.2.3 of the core 4C System Regulations regarding Risk Assessment, sample size calculation and selection, the following specific requirements shall be complied with.

*Specific requirements*

As a general rule, the Carbon Footprint Add-On audit is combined with the 4C core certification audit. In order to combine both audits, the sample of BP producers and BP processors to be audited should be selected by the auditor in such a way that both scopes of audit (core and Add-On) are covered in the final sample.

*Sample selection*

It is important to observe that the sample for the audit differs from the calculation sample. The calculation sample is something that should be conducted by the Managing Entity to get solid results on the calculations of the CF of a certain 4C Unit. On the other hand, the audit sample aims to verify if the procedures for data registration and collection are being correctly executed by BP Producers and BP processors, and if they are implementing correctly the actions planned in the IP\_CF.

*Audit sample size*

As per the requirements of the core 4C certification, the Managing Entity always need to be audited. When auditing the ME, the CB will have the responsibility to check if the methodology of the calculations was correctly applied and the formulas are consistent, if the IP\_CF is correctly developed and if the ME has a management plan to guarantee the CF Add-on implementation. There are checkpoints related to the ME and the calculations could be audited remotely.

*Always includes ME in the audit*

To select the sample for the audit, CBs need to apply the current requirements on risk assessment for the core 4C certification audit to determine the final risk levels for BP\_Producers and BP\_Service Providers. The sample size of BP Producers and BP Service Providers for the core 4C certification varies according to the final risk levels, as stated in the 4C System Regulations. **The minimum sample size calculated for core 4C certification is the minimum sample size for the combined audit.**

*Minimum sample size calculation*

If the whole 4C unit applies for the CF Add-On, at least one BP audited in the first CF certification audit shall be part of the original calculation sample. In case a sub-unit of the 4C Unit applies for the CF Add-On, the combined audit sample must include:

*Combined sample selection*

- BPs outside the scope of the CF Add-On, in order to cover the requirements for the 4C risk assessment and sample selection
- At least one BP part of the CF add-on original calculation sample

As per the core 4C certification regulations, auditors and CBs have the right to increase the sample of the audit if they observe high risk situations or have difficulties in covering both scopes only by adopting the minimum sample size.

*Possible to increase minimum sample*

## 5.2.4 Conduction of the Audit

In line with the procedures applicable for the 4C core certification, 4C prescribes additional checklists to CBs which shall be used during the Add-On certification audits to verify the compliance with the Carbon Footprint Add-On requirements. Carbon Footprint Add-On audit checklists are working documents containing specific checkpoints and verification guidance.

*Checklists to verify compliance*

Carbon Footprint Add-On audit checklists are available for producing groups (4C Units) and Chain of Custody and contain levels of compliance in line with the different possibilities to implement the Add-On:

*Checklists according to the levels*

**Carbon Footprint verification (level 1):** GHG emissions calculation at the 4C Unit level. In this case, only the checkpoints related to the GHG emissions calculation are relevant.

*Unit Level*

**Carbon Footprint verification (level 2):** GHG emissions calculation at the 4C Unit level and Intermediary Buyers and optional Final Buyers. Similar to level 1, it includes the checkpoints related to the GHG emissions calculation covering the entire supply chain. The audit checklists for 4C Units and IB/FB (Chain of Custody) are two different documents, with different checkpoints, according to the respective scopes.

*Unity Level and Intermediary Buyers*

**Climate Friendly Coffee certification (level 3):** Includes the reduction of the GHG emissions. For this situation, in addition to checkpoints described in the previous items, there are checkpoints related to the reduction of the GHG emissions.

*Reduction of GHG emissions*

**Climate Neutral Coffee certification (level 4):** Includes carbon compensation. At this level of implementation, the checklist provides additional checkpoints related to the compensation measures of own emissions by purchasing carbon credits from certified offsetting projects.

*Carbon compensation*

*4C procedures apply to the Add-On*

The remaining procedures related to the completion of the checklists, their evaluation by the CBs evaluators, the treatment of non-conformities, uploading to the 4C Portal and other details as described in the 4C System Regulations are also applicable for the 4C Climate Friendly Coffee certification.

## 5.2.5 Audit Report Evaluation and Certification Decision

As stated before, a positive certification decision for the Carbon Footprint Add-On can only happen after a positive certification decision about the core 4C certification. The following outcomes are possible:

*Possible certification decisions*

- Possibility 1: Positive 4C core certificate + Positive 4C CF Add-On certificate
- Possibility 2: Positive 4C core certificate + Negative 4C CF Add-On certificate

A negative decision on the add-on certification does not interfere in the certification decision of the core 4C certification.

The CB has 60 days to make a decision on the Add-On certification. This deadline is counted from the last audit date.

*Deadlines to make certificate decision*

As to ensure high quality and reliability of calculations and results and that the individual GHG calculations are done correctly by following the described methodology, all GHG calculations have to be forwarded to 4C for an additional assessment after verification by the CB/auditor. The CB can only make the certification decision after getting the final confirmation by 4C. The reassessment of 4C is mandatory and included in the deadline period of 60 days as stated above.

*Reassessment  
of GHG results*

The validity of the CF add-on certificate is 3 years and can only be used when the core 4C certificate is valid. This way, it is not possible to extend and backdate the Add-On certificate.

*CF certificate  
validity*

The validation of the certification documents uploaded by the CB follows the same rule as stated in the chapter 5.2.4, 4C System regulations.

*4C validation*

### 5.3 Maintenance of the Carbon Footprint Add-On Certification

For the recertification audit, the baseline will be referred to the one calculated during the initial certification. During any interruption after 3 years and continuation of 4C Climate Friendly or Neutral Coffee certification, the baseline of initial certification will be accounted. This implies that no units are allowed to use more inputs (synthetic fertilizers, pesticides etc.) during the interruption period or conducting any activities to increase the emission and calculate a new baseline based on those inputs. This is to ensure that increasing emissions are no longer allowed.

*Baseline value  
and interruption  
period*

In addition to the procedures and requirements described in chapter 5.3 of the core 4C System Regulations, the following requirements shall be complied with. As for the core 4C certification of producing groups (4C Units), the additional annual update procedure for Carbon Footprint is also mandatory to maintain the Carbon Footprint Add-On certification.

*Annual Updates  
and surveillance  
audits*

After the first and second year of the Carbon Footprint Add-On certification, the ME must submit an updated set of documents respectively called Annual Updates (AU\_CF) to its contracted CB, which includes the updated BPM, recalculations, and IP\_CF. The IP\_CF document is not applicable for implementation levels 1 and 2 as already outlined in the previous chapters of this document. The content of the IP\_CF is detailed in chapter 4 of this document.

*Annual Updates  
are mandatory*

The CB then evaluates and approves the Annual Updates, by checking if all documents have been handed in correctly and filled in completely. In case of doubts, a CF surveillance audit may follow to ensure the implementation of the 4C Add-On requirements. Approved AU\_CF documents must be uploaded to the 4C portal by the CB.

*Approval of  
Annual Updates*

In the case of 4C Chain of Custody certification, verification of the updated BPM, recalculations, and IP\_CF is done during CF surveillance audits.

*Chain of  
Custody*

To update the calculations, the ME or the IB/FB (CoC certificate holder) needs to apply the same sample requirements for the calculation of the sample size, such as the first calculation, select the sample and recalculate the emissions. Half of the sample for the recalculation shall include BPs that were part of the original calculation, while the other half shall be composed of new BPs.

*Sample for  
recalculation*

In case the CF Add-On certification audit is not conducted in combination with core 4C audit, for the AU\_CF, an entire 12 months period is required to reflect the data collection and GHG emission recalculation requirements. During the 3-year CF certification cycle, there are 2 AU\_CFs. Therefore, after every 12 months of the certification issuance date, AU\_CF is required and it is no longer

*Non-combined  
audits*

needed to coincide with the core 4C audit Annual Update deadlines. The CF certificate remains valid only when the 4C core certificate is valid.

## 6 4C Climate Neutral Coffee Certification

4C Climate Friendly Coffee can be upgraded to 4C Climate Neutral Coffee, reaching the highest level of the Carbon Footprint Add-On certification process, as described in chapters 2 and 4. The purpose of 4C Climate Neutral Coffee certification is to certify that **climate neutrality** is achieved. This means that all the emissions occurring in the coffee production process that cannot be reduced are compensated (or offset), by financing GHG mitigation projects beyond the coffee value chain (i.e., carbon offsetting).

*The purpose of  
4C Climate  
Neutral Coffee*

The 4C Climate Neutral coffee certificate will show that carbon neutrality is achieved through the combination of GHG reduction measures and the compensation of remaining emissions. Furthermore, 4C Climate Neutral certification ensures that climate neutrality is reached through certified and traceable GHG mitigation projects contributing to the UN Sustainable Development Goals (SDGs) and generation high-quality carbon credits.

*Achieving  
climate neutrality*

This chapter provides a general overview on carbon compensation mechanism (or offsetting) to introduce the requirements to receive the 4C Climate Neutral Coffee certification.

### 6.1 Carbon Compensation Mechanism

Carbon compensation (or offsetting) is a policy instrument to enhance sustainability through the mitigation of GHG emissions. It is an instrument that allows companies to reach climate neutrality in the short term, by offsetting the GHG emissions they cannot reduce. This means buying carbon credits from certified GHG mitigation projects developed in one location, to compensate an equivalent emission occurring in another location. In other words, when a company wants to offset GHG emissions that cannot be reduced directly, it can economically contribute to a project aimed at mitigating GHG emissions in a different location, and that generates carbon credits. GHG emission compensation or carbon offsetting is also defined as GHG mitigation beyond the value chain to clearly distinguish carbon offsetting from carbon insetting (i.e., GHG mitigation inside the value chain).

*Carbon  
compensation as  
policy instrument*

One carbon credit represents one ton of CO<sub>2</sub> equivalent that has been mitigated due to the project activities. The company receives carbon credits for its contribution to the emission reduction project in a proportional amount to the money invested and uses these to compensate its emissions.

Carbon credits projects may address different sectors (e.g., agriculture, forestry, renewable energy, energy efficiency, methane capture, etc.). To generate carbon credits, a project needs to meet specific requirements (e.g., mitigate GHG emission with additionally to the business-as-usual, ensure permanence over time and avoid double counting), apply approved methodologies, and successfully pass third-party verification.

*Requirements of  
offsetting project*

Once the credits are issued, they are stored in the registries owned by certification standards, and they are retired when a company purchases them (to avoid they are sold twice). A certificate certifying the purchase and the retirement of the credits from the respective registry is released as proof of carbon compensation. This certificate can be used by the company to demonstrate the compensation of the respective GHG emissions.

*Carbon credits  
purchase and  
retirement*

### 6.1.1 General Requirements

The general requirements applying for 4C Climate Friendly Coffee apply also for 4C Climate Neutral Coffee. In addition, the specific requirements listed in chapter 6.1.2 shall also apply.

*Climate Neutral  
Coffee  
Requirements*

### 6.1.2 Specific Requirements

The upgrade to Climate Neutral coffee is only possible if the Climate Friendly certification has been reached and is in place. For this level of certification, the prerequisite is the GHG emission reduction. In the first years of Climate Friendly certification, the GHG calculation and the implementation of the Improvement Plan (IP\_CF) is considered as valid as it proves the commitment to GHG emission reduction. Therefore, in the first years of the certification, the Climate Neutral certification can be run simultaneously with Climate Friendly certification until the GHG emission reduction is verified. This implies that the entire GHG emission can be compensated in the first years until the GHG emission reduction is verified.

*GHG emission  
reduction as  
prerequisite*

In the following years, the emission reduction led by the implemented IP\_CF should lead to GHG emission reductions, 5 can be demonstrated in an updated version of the baseline GHG calculation or in the recalculation of the following year during the same certification cycle.

The expected GHG emission reduction set in chapter 5 shall be demonstrated every year, to keep the 4C Climate Neutral Coffee certification. This is to ensure a continuous GHG emission reduction pathway and the integration with carbon compensation in a proper proportion. As a result, with the improvement in GHG emissions, the carbon credits needed for carbon compensation and 4C Climate Neutral Coffee certification will proportionally decrease overtime.

If any increase in GHG emission is detected the Climate Neutral status will be withdrawn, together with Climate Friendly status.

Additionally, the remaining emissions after the application of GHG emission reduction measures or the GHG emission that cannot be reduced, must be compensated. This must be done by purchasing an equal amount of carbon credits by a certified carbon credits project. 4C Climate Neutral Coffee certification shall only accept high-quality certified carbon credits, ensuring the contribution to SDGs and environmental (e.g., biodiversity loss reduction, ecosystem services provision) and social (e.g., improve livelihood of local communities) co-benefits, beyond the GHG mitigation. Ideally, the carbon credits must be purchased certified carbon credits projects, reliability, and permanence of GHG emission mitigation. However, ex-ante credits can be accepted, in case suitable projects (i.e., meeting all the previously mentioned requirements) are identified. The use of ex-ante carbon credits is only allowed if 4C is duly informed about the project characteristics and gives approval for the use of ex-ante carbon credits before the purchase for compensation purposes takes place.

*Compensation  
with high-quality  
credits*

All the information on carbon credits used to compensate GHG emissions shall be forwarded to 4C for approval. 4C may also support the selection of high-quality carbon credits and reliable offsetting projects suitable for compensation purposes.

*Approval of  
carbon credits*

## 6.2 Verification of Compensation

After purchasing carbon credits, these must be retired from the respective registry on behalf and with the name of the compensating company, to which a compensation proof (usually known as certificate of compensation) is released. This proof needs to be provided to 4C for check and validation.

*Compensation  
proof*

## 6.3 Accounting of Carbon Compensation

GHG emissions, compensated by the purchase of high-quality carbon credits (offsetting), and certified under 4C Climate Neutral Coffee will remain separated and cannot be directly accounted for in the general formula. Offset GHG emissions are required to be reported independently from the main calculation and the IP\_CF.

*Compensation is  
reported  
separately*



## 7 Claims and Logo Use

The use of the 4C Climate Friendly Coffee logo and 4C Climate Neutral Coffee logo is meant to allow users of the 4C System to communicate and signify their achievements regarding implementing measures to contribute to climate protection in the coffee sector.

*Marketing claims*

Compliance with the Carbon Footprint Add-On requirements is the basis for possible on-product claims on final products (e.g., on-pack labels) and off-product claims (e.g., website, social media, etc.). Therefore, a valid Carbon Footprint Add-On amendment substantiated by the respective level of implementation is the prerequisite for the on-product and off-product use of the 4C Climate Friendly Coffee and/or 4C Climate Neutral Coffee logos and related text claims by all 4C certificate holders.

*Compliance and Claims*

Companies can start to promote their efforts to mitigate climate change from levels of implementation 1 and 2, which can be communicated by certificate holders using the term "4C Verified GHG emissions" or similar claims, as long as they do not convey the message of GHG emission reduction or neutrality and clearly indicate the system boundary of the calculation. The use of the 4C Climate Friendly Coffee logo is possible for certificate holders that have chosen level of implementation 3 and the use of the 4C Climate Neutral Coffee logo is possible for companies that have chosen level of implementation 4.

*Claims per level of implementation*

Other 4C users such as Certification Bodies and other stakeholders as referred to in Table 2 can also use the logos and claims referred to in this chapter, as long as the conditions described within this document are met.

*Logo usage by stakeholders*

The general requirements regarding the core 4C logo use and claims described in chapter 10 of the 4C System Regulations shall also be complied with for the 4C Climate Friendly Coffee and 4C Climate Neutral Coffee logos. The 4C Climate Friendly Coffee logo (Figure 18) and the 4C Climate Neutral Coffee logo (Figure 19) holds copyright protection and is a registered trademark.

*Logo usage*



*Figure 18: 4C Climate Friendly Coffee logo*



*Figure 19: 4C Climate Neutral Coffee logo*

General sustainability-related claims which do not directly reference "4C Climate Friendly Coffee" and/or "4C Climate Neutral Coffee" (e.g., "climate friendly coffee or product", "climate neutral coffee or product", etc.) are not subject to approval by 4C. As no "official approval" of such general claims by

*Claims requirements*

4C is required, companies can freely decide to use such claims. When making such general claims, it shall be avoided that third parties are given the impression that the claim directly relates or references to “4C Climate Friendly Coffee” and/or “4C Climate Neutral Coffee”.

To obtain approval by 4C and to receive the logo file, interested parties should send a request to 4C via the official 4C e-mail address (info@4c-services.org). It should be clearly stated in the request for which use or application the logo and claims are intended and where they will be placed. 4C is also happy to further support on individual requests.

Any direct claim, statement or reference made to the terms “4C Climate Friendly Coffee” and/or “4C Climate Neutral Coffee” that is not in line with the respective rules outlined in this chapter will be regarded as “unauthorized”.

On the quantity/volume of certified coffee purchased and/or packaged by a given coffee brand, the same conditions described in the 4C System Regulations (chapter 10.5) must be complied with. In addition to the requirements described in the 4C System Regulations, the following table (Table 3) shall be used as a guideline for off-product claims.

*Receiving the logo*

*Unauthorized claims*

*Guideline for off-product claims*

*Table 3: Requirements for off-product claims*

| Interest group |  | Requirements on claims   |
|----------------|--|--|
| 1.             | Managing Entities of 4C Units<br>(agricultural production certificate holders) | Claim shall refer to the Carbon Footprint Add-On certification according to the corresponding level of implementation. Examples:<br>Level 1 and 2: "4C Verified GHG emissions", "Green Coffee 4C Verified GHG emissions"<br>Level 3: "4C Climate Friendly Coffee", "Green Coffee 4C Climate Friendly Coffee"<br>Level 4: "4C Climate Neutral Coffee". "Green Coffee 4C Climate Neutral Coffee"   |
| 2.             | Intermediary or Final Buyers<br>(chain of custody certificate holders)         | Claim shall refer to the Carbon Footprint Add-On certification according to the corresponding level of implementation and system boundary. Examples:<br>Level 1 and 2: "4C Verified GHG emissions (e.g. for coffee production, incl. supply chain, incl. roasting)"<br>Level 3: "4C Climate Friendly Coffee", "Company trades 4C Climate Friendly Coffee", "Roast & Ground 4C Climate Friendly Coffee"<br>Level 4: "4C Climate Neutral Coffee", "Company trades 4C Climate Neutral Coffee", "Roast & Ground 4C Climate Neutral Coffee" |
| 3.             | Certification Bodies   | Claim shall refer to the cooperation, e.g., "Carbon Footprint Add-On cooperating Certification Body"   |
| 4.             | Other stakeholders (e.g., project-related partner)                             | Claim shall refer to partnership or relationship with 4C, e.g., "GHG project was conducted together with 4C"   |

## Annex I: Emission Factors

The choice of emission factors has an impact on the results of the GHG emissions calculation.

**Emission factors** describe the relationship between the amount of released GHG emissions and the amount of input material. They are needed in order to calculate the CO<sub>2</sub>eq emissions related to a specific input material. Emission factors for energy supply shall include direct and indirect effects. Direct effects are air emissions from combustion, waste, effluents and electricity use. Indirect effects are the upstream emissions of a material. They include, e.g., emissions from processing steps. Both factors – direct and indirect – shall be considered in the emission factor used.

*Relevant parts of emission factors*

The variability of individual emission factors may be large and for some inputs emission factors might not be available or just an approximation can be used. However, to avoid cherry picking and to support objective, transparent and verifiable Individual calculations and audits, 4C has developed a list of frequently used emission factors. The list is mainly based on the list of standard calculation values published on the European Commission website, Biograce, national/country reports and Ecoinvent (version 3.9.1, Allocation cut-off; IPCC 2013; GWP 100a). Alternative values are allowed only if they belong to a scientific and peer-reviewed sources or official national sources (e.g., government ministry publications, National Inventory Report).

*Possible sources*

The following overview will be updated by 4C on a continuous base as soon as databases (e.g., Ecoinvent) provide new published values. This list should serve as an overview of some of the most frequently used emission factors relevant for the coffee supply chain without any guarantee for completeness. Alternative factors can be used as long as they are taken from an officially recognized or credible source that can be verified by the auditor.

*Frequently used emission factors*

The emission factors RER (Rest of Europe) can be used for European countries, the emission factors RoW (Rest of the World) for all other countries. Emission factors listed as GLO (Global) can be used for any country. If there are specific emission factors for individual countries, they are listed and highlighted separately.

*Factor specifics*

The greenhouse gases considered for all GHG calculations shall be CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>. For the purposes of calculating CO<sub>2</sub> equivalence, those gases shall be valued with their GWPs as follows<sup>36</sup>:

- CO<sub>2</sub>: 1
- CH<sub>4</sub>-Fossil: 29.8
- CH<sub>4</sub>-Non-Fossil: 27
- N<sub>2</sub>O: 273

<sup>36</sup> IPCC (2021): *The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate.*  
[https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC\\_AR6\\_WGIII\\_SPM.pdf](https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf)

| FREQUENTLY USED EMISSION FACTORS<br>AND THEIR RESPECTIVE SOURCES          |  |                 |   |
|---|--|-----------------|---|
| Input   | Unit   | Standard factor | Source, description   |
| <b>A) Emission factors for cultivation</b>                                |  |                 |   |
| <b>Fertilizers</b>  |  |                 |   |
| CaO-fertilizer  | kg CO <sub>2</sub> eq/kg CaO                           | 0.13            | European Commission: <a href="#">Standard values for emission factors</a> , v 1.0. 2015 |
| Calcium ammonium nitrate  | kg CO <sub>2</sub> eq/kg CaN                           | 3.67            | European Commission: Standard values for emission factors, v 1.0. 2015                  |
| Diammonium phosphate (DAP)  | kg CO <sub>2</sub> eq/kg DAP                           | 1.6065          | Ecoinvent v.3.9.1 (2022), diammonium phosphate production, RoW                          |
| K <sub>2</sub> O-fertilizer   | kg CO <sub>2</sub> eq/kg K <sub>2</sub> O              | 0.576           | European Commission: <a href="#">Standard values for emission factors</a> , v 1.0. 2015 |
| Limestone (CaCO <sub>3</sub> )  | kg CO <sub>2</sub> eq/kg CaCO <sub>3</sub>             | 0.40142         | Ecoinvent v.3.9.1 (2022), market for calcium carbonate, precipitated, RoW               |
| Magnesium oxide   | kg CO <sub>2</sub> eq/kg MgO                           | 2.0728          | Ecoinvent v.3.9.1 (2022), market for magnesium oxide, GLO                               |
| Muriate of potash (Potassium chloride)                                    | kg CO <sub>2</sub> eq/kg K <sub>2</sub> O              | 0.4659          | Ecoinvent v.3.9.1 (2022), market for potassium chloride, RoW                            |
| Monoammonium phosphate  | kg CO <sub>2</sub> eq/kg N                             | 1.0299          | Ecoinvent v.3.9.1 (2022), monoammonium phosphate production, RoW                        |
| N-fertilizer  | kg CO <sub>2</sub> eq/kg N <sup>37</sup>               | 5.881           | European Commission: <a href="#">Standard values for emission factors</a> , v 1.0. 2015 |
| NPK fertilizer (15-15-15)   | kg CO <sub>2</sub> eq/kg N                             | 1.4594          | Ecoinvent v.3.9.1 (2022), market for NPK (15-15-15) fertilizer, RoW                     |
| NPK fertilizer (26-15-15)   | kg CO <sub>2</sub> eq/kg N                             | 2.3776          | Ecoinvent v.3.9.1 (2022), market for NPK (26-15-15) fertilizer, RoW                     |
| P <sub>2</sub> O <sub>5</sub> -fertilizer                                 | kg CO <sub>2</sub> eq/kg P <sub>2</sub> O <sub>5</sub> | 1.011           | European Commission: <a href="#">Standard values for emission factors</a> , v 1.0. 2015 |
| Urea  | kg CO <sub>2</sub> eq/kg N                             | 1.7239          | Ecoinvent v.3.9.1 (2022), market for urea, RoW  |
| <b>Specific fertilizer production emissions for Southeast Asia Region</b> |  |                 |   |
| Ammonium nitrate - 33.5% N (granulated)                                   | Kg CO <sub>2</sub> eq/kg of product                    | 2,39            | Brentrup et al., 2018, pg 4.  |

<sup>37</sup> For all N-fertilizers the emission factor refers to the amount of nitrogen in the fertilizer.

|  |                                     |      |                              |
|--|-------------------------------------|------|------------------------------|
| Ammonium nitrate - 33.5% N (prilled)   | Kg CO <sub>2</sub> eq/kg of product | 2,34 | Brentrup et al., 2018, pg 4. |
| Ammonium sulphate - 21% N  | Kg CO <sub>2</sub> eq/kg of product | 0,65 | Brentrup et al., 2018, pg 4. |
| Ammonium sulphate nitrate - 26% N  | Kg CO <sub>2</sub> eq/kg of product | 1,35 | Brentrup et al., 2018, pg 4. |
| Anhydrous ammonia - 82% N  | Kg CO <sub>2</sub> eq/kg of product | 2,38 | Brentrup et al., 2018, pg 4. |
| Calcium ammonium nitrate - 27%N  | Kg CO <sub>2</sub> eq/kg of product | 1,96 | Brentrup et al., 2018, pg 4. |
| Calcium nitrate - 15.5%N   | Kg CO <sub>2</sub> eq/kg of product | 1,68 | Brentrup et al., 2018, pg 4. |
| Compound NPK - 15% N/ 15% K <sub>2</sub> O/ 15% P <sub>2</sub> O <sub>5</sub> (mixed-acid process)     | Kg CO <sub>2</sub> eq/kg of product | 1,13 | Brentrup et al., 2018, pg 4. |
| Compound NPK - 15% N/ 15% K <sub>2</sub> O/ 15% P <sub>2</sub> O <sub>5</sub> (nitrophosphate process) | Kg CO <sub>2</sub> eq/kg of product | 1,22 | Brentrup et al., 2018, pg 4. |
| Diammonium phosphate - 18% N /46% P <sub>2</sub> O <sub>6</sub>  | Kg CO <sub>2</sub> eq/kg of product | 0,74 | Brentrup et al., 2018, pg 4. |
| Monoammonium phosphate - 11% N /52% P <sub>2</sub> O <sub>5</sub>                                      | Kg CO <sub>2</sub> eq/kg of product | 0,55 | Brentrup et al., 2018, pg 4. |
| Super phosphate - 21% P <sub>2</sub> O <sub>5</sub>  | Kg CO <sub>2</sub> eq/kg of product | 0,11 | Brentrup et al., 2018, pg 4. |
| Triple super phosphate - 21% P <sub>2</sub> O <sub>5</sub>   | Kg CO <sub>2</sub> eq/kg of product | 0,25 | Brentrup et al., 2018, pg 4. |
| Urea 46%   | Kg CO <sub>2</sub> eq/kg of product | 0,93 | Brentrup et al., 2018, pg 4. |
| Urea ammonium nitrate solution 32%N  | Kg CO <sub>2</sub> eq/kg of product | 1,36 | Brentrup et al., 2018, pg 4. |

| <b>Pesticides</b>  |   |   |  |
|--|---|---|--|
| Chlorothalonil   | kg CO <sub>2</sub> eq/kg                    | 4.2552  | Ecoinvent v.3.9.1 (2022), chlorothalonil production, RoW   |
| Glyphosate   | kg CO <sub>2</sub> eq/kg                    | 11.9  | Ecoinvent v.3.9.1 (2022), glyphosate production, RoW   |
| Mancozeb   | kg CO <sub>2</sub> eq/kg                    | 7.105   | Ecoinvent v.3.9.1 (2022), mancozeb production, RoW   |
| Pesticides (general value)                                 | kg CO <sub>2</sub> eq/kg a.i. <sup>38</sup> | 10.97   | European Commission: Standard values for emission factors, v 1.0. 2015                                       |
| <b>Other inputs</b>  |   |   |  |
| Seedlings  |   |   |  |
| Coffee seedlings (with roots, externally bought)           | kg CO <sub>2</sub> eq/kg                    | 1.2522  | Ecoinvent v.3.9.1 (2022), fruit tree seedling production, for planting, RoW                                  |
| <b>B) Emission factors for processing</b>                  |   |   |  |
| <b>Process inputs</b>                                      |   |   |  |
| Process water  | kg CO <sub>2</sub> eq/kg                    | Europe without CH: 0.00030884<br>RoW: 0.0012409 | Ecoinvent v.3.9.1 (2022), market for tap water   |
| Packaging material (jute)                                  | kg CO <sub>2</sub> eq/kg                    | 2.3529  | Ecoinvent v.3.9.1 (2022), market for textile, jute, GLO  |
| Packaging material (plastic)                               | kg CO <sub>2</sub> eq/kg                    | 3.1131  | Ecoinvent v.3.9.1 (2022), market for packaging film, low density polyethylene, GLO                           |
| Packaging material (paper)                                 | kg CO <sub>2</sub> eq/kg                    | 0.94294   | Ecoinvent v.3.9.1 (2022), kraft paper production, RoW  |
| <b>Electricity consumption from grid (electricity mix)</b> |   |   |  |
| EU   | kg CO <sub>2</sub> eq/kWh <sub>el</sub>     | 0.296   | N. Scarlat, et.al, (2022). Quantification of the carbon intensity of electricity produced and used in Europe |
| Brazil   | kg CO <sub>2</sub> eq/kWh <sub>el</sub>     | 0.12  | Ministério da Ciência, Tecnologia e Inovações (2021). Fatores de emissão.                                    |
| China  | kg CO <sub>2</sub> eq/kWh <sub>el</sub>     | 0.55  | Climate Transparency. Country Profile China 2019.  |

<sup>38</sup> Active ingredient

|  |  |   |   |
|--|--|---|---|
| Colombia   | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.12  | Unidad de Planeación Minero Energética (2022). Resolución No. 320   |
| Honduras   | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.61  | CDM Standardized baseline "Honduran Grid Emission Factor Version 01.0 (ASB0042-2019)                                  |
| India  | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.81  | Central Electricity Authority (2021). CDM CO <sub>2</sub>   |
| Indonesia  | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.71  | Carbon Footprint Ltd. (2020). Emissions Factors & Sources for 2021 Electricity.                                       |
| Kenya  | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.49  | CDM Standardized baseline "Grid Emission Factor for the Republic of Kenya" version 01.0 (ASB0050-2020)                |
| Malaysia   | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.64  | IGES (2017). Grid Emission Factor (GEF) for the Asia-Pacific region   |
| Mexico   | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.43  | Secretaría de Medio Ambiente y Recursos Naturales (2022). Aviso Factor de Emisión.                                    |
| Philippines  | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.69  | Department of Energy, the Philippines 2015-2017 National Grid Emission Factor (NGEF)                                  |
| Rwanda   | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.537   | National Inventory Report Rwanda September (2018).  |
| Tanzania   | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.5081  | IGES List of Grid Emission Factors V10.11 (2021)  |
| Thailand   | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.56  | Thailand Grid Emission Factor for GHG Reduction Project/Activity (2016)   |
| Uganda   | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.27  | CDM Standardized baseline: "Grid emission factor for the national power grid of Uganda version 01.0" (ASB0054) (2022) |
| Vietnam  | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.72  | Ministry of Resources and Environment (2021). Electric emission coefficients Vietnam                                  |
| <b>Energy consumption from internal production</b> |  |   |   |
| Diesel   | kg CO <sub>2</sub> e/L                     | 1.082   | Ecoinvent v.3.9.1 (2022), market for diesel, low-sulfur, RoW  |
| Petrol   | kg CO <sub>2</sub> eq/L                    | 3.18  | Eggleston & Walsh (2000) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories     |
| Heat from boiler (NG)                              | kg<br>CO <sub>2</sub> eq/MJth              | Europe without<br>CH:<br>0.075656<br><br>RoW:<br>0.074026 | Ecoinvent v.3.9.1 (2022), heat production, natural gas, at industrial furnace >100kW                                  |
| Natural gas  | kg CO <sub>2</sub> eq/MJ                   | 4000 km,<br>Russian quality:<br>0.066                     | European Commission: Standard values for emission factors, v 1.0. 2015  |

|  |  |   |   |
|--|--|---|---|
|  |  | 4000 km,<br>EU Mix quality:<br>0.0676             |   |
| Solar electricity                                  | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.084838  | Ecoinvent v.3.9.1 (2022), electricity production, photovoltaic, 3kWp flat-roof installation, single-Si, RoW   |
| Waste wood (external, upstream emissions)          | kg CO <sub>2</sub> eq/kg                   | 0.048037  | Ecoinvent v.3.9.1 (2022), treatment of waste wood, post-consumer, sorting and shredding, RoW  |
| Waste wood – CO <sub>2</sub> combustion emissions  | kg CO <sub>2</sub> /kg                     | 1.61  | IPCC 2006 Guidelines for National Greenhouse Gas Inventories, <a href="http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html">http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html</a> |
| Waste wood – CH <sub>4</sub> combustion emissions  | kg CH <sub>4</sub> /kg                     | 0.00432   | IPCC 2006 Guidelines for National Greenhouse Gas Inventories, <a href="http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html">http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html</a> |
| Waste wood – N <sub>2</sub> O combustion emissions | kg N <sub>2</sub> O/kg                     | 0,0000576   | IPCC 2006 Guidelines for National Greenhouse Gas Inventories, <a href="http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html">http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html</a> |
| Wind electricity                                   | kg<br>CO <sub>2</sub> eq/kWh <sub>el</sub> | 0.014748  | Ecoinvent v.3.9.1 (2022), Electricity production, wind, 1-3MW turbine, onshore, RoW   |
| <b>Waste treatment</b>                             |  |   |   |
| Wastewater treatment (externally)                  | kg CO <sub>2</sub> eq/cbm                  | Europe without<br>CH: 0.36367<br><br>RoW: 0.27207 | Ecoinvent v.3.9.1 (2022), market for wastewater, average  |
| Coffee wastewater methane emissions (on-site)      | kg CO <sub>2</sub> / kg wastewater         | 0.375   | Federación Nacional de Cafeteros de Colombia Centro Nacional de Investigaciones de Café Cenicafé, Environmental Footprint of Coffee in Colombia - Guidance Document ; Page 47                 |
| Composting of residues                             | kg CO <sub>2</sub> eq/kg                   | 0.016034  | Ecoinvent v.3.9.1 (2022), treatment of garden biowaste, home composting in heaps, RoW   |
| Pulp treatment (decomposition of pulp)             | kg CH <sub>4</sub> /t green coffee         | 6.22  | Federación Nacional de Cafeteros de Colombia Centro Nacional de Investigaciones de Café Cenicafé, Environmental Footprint of Coffee in Colombia - Guidance Document ; Page 48                 |



| C) Emission factors for transport & distribution |                                  |                              |  |
|--|----------------------------------|------------------------------|--|
| Car  | kg CO <sub>2</sub> eq/ton-km     | 2.0788                       | Ecoinvent v.3.9.1 (2022), transport, freight, light commercial vehicle, RoW  |
| Diesel   | kg CO <sub>2</sub> eq/liter      | 3.14                         | Biograce v 4d, 2014  |
| Diesel consumption car (loaded)                  | L/km                             | 0.08                         | GFEI (2017) Fuel Economy In Major Car Markets: Technology And Policy Drivers 2005-2017. Working Paper 19   |
| Diesel consumption car (unloaded)                | L/km                             | 0.08                         | Gfei (2017) Fuel Economy In Major Car Markets: Technology And Policy Drivers 2005-2017. Working Paper 19   |
| Diesel consumption motorbike (loaded)            | L/km                             | 0.02                         | lcct (2022) Two-Wheelers In Vietnam: A Baseline Analysis Of Fleet Characteristics And Fuel Consumption In 2019 And 2020. Working Paper 2022-08, Pg. 7. |
| Diesel consumption motorbike (unloaded)          | L/km                             | 0.02                         | lcct (2022) Two-Wheelers In Vietnam: A Baseline Analysis Of Fleet Characteristics And Fuel Consumption In 2019 And 2020. Working Paper 2022-08, Pg. 7. |
| Diesel consumption truck (loaded)                | L/km                             | 0.49                         | BLE, 2010, Guideline Sustainable Biomass Production  |
| Diesel consumption: truck (unloaded)             | L/km                             | 0.25                         | BLE, 2010, Guideline Sustainable Biomass Production  |
| Electricity consumption train (electricity)      | kWh/ton-km                       | 0.06                         | Biograce v 4d, 2014. Conversion factor 1 MJ = 0.28 kWh   |
| Freight, lorry                                   | kg CO <sub>2</sub> eq/ton-km     | RER: 0.14871<br>RoW: 0.15331 | Ecoinvent v.3.9.1 (2022), market for transport, freight, lorry, unspecified  |
| Motorbike  | kg CO <sub>2</sub> eq/person* km | 0.13349                      | Ecoinvent v.3.9.1 (2022), market for transport, passenger, motor scooter, GLO  |
| Truck 3.5-7.5t                                   | kg CO <sub>2</sub> eq/ton-km     | 0.58726                      | Ecoinvent v.3.9.1 (2022), for transport, freight, lorry 3.5-7.5 metric ton, EURO3, RoW   |
| Truck 7.5-16t                                    | kg CO <sub>2</sub> eq/ton-km     | 0.24435                      | Ecoinvent v.3.9.1 (2022), market for transport, freight, lorry 7.5-16 metric ton, EURO3, RoW   |
| Truck 16-32t                                     | kg CO <sub>2</sub> eq/ton-km     | 0.19259                      | Ecoinvent v.3.9.1 (2022), market for transport, freight, lorry 16-32 metric ton, EURO3, RoW  |
| Truck >32t                                       | kg CO <sub>2</sub> eq/ton-km     | 0.10648                      | Ecoinvent v.3.9.1 (2022), market for transport, freight, lorry > 32 metric ton, EURO3, RoW   |

|                            |   |  |   |
|----------------------------|---|--|---|
| Freight train              | kg CO <sub>2</sub> eq/ton-km                        | Europe without CH:<br>0.046771<br><br>RoW:<br>0.052259 | Ecoinvent v.3.9.1 (2022), market for transport, freight train                           |
| Heavy fuel oil (HFO)       | kg CO <sub>2</sub> eq/L<br>kg CO <sub>2</sub> eq/MJ | 3.42<br>0.085  | Biograce v 4d, 2014<br>European Commission: Standard values for emission factors        |
| HFO for maritime transport | kg CO <sub>2</sub> eq/MJ                            | 0.087  | European Commission: Standard values for emission factors, v 1.0. 2015                  |
| Barge tanker               | kg CO <sub>2</sub> eq/ton-km                        | RER: 0.047025<br><br>RoW:<br>0.047739                  | Ecoinvent v.3.9.1 (2022), market for transport, freight, inland waterways, barge tanker |
| Transoceanic tanker        | kg CO <sub>2</sub> eq/ton-km                        | 0.010164   | Ecoinvent v.3.9.1 (2022), market for transport, freight, sea, container ship, GLO       |

## Annex II: GHG reduction and Carbon Removal Measures:

| GHG Reduction measures   | Carbon Removal measures  |
|--|--|
| <b>Cultivation</b>   |  |
| Fertilizer reduction   | Reduced deforestation and forest degradation                     |
| Pesticide reduction  | Increased soil organic carbon content                            |
| Reduction of energy consumption  | Reduced post-harvest losses                                      |
| Soil carbon accumulation via improved agricultural management                      | Agroforestry   |
| Soil fertility restoration and use of degraded land                                | Agricultural diversification                                     |
| Soil health improvement  | Increasing shade/coffee tree density                             |
| Soil acidity remediation   | Soil carbon accumulation via improved agricultural management    |
| Soil erosion reduction   | Soil fertility restoration and use of degraded land              |
| Methane capture from agricultural activities                                       | Soil health improvement  |
| Agroforestry   | Methane capture using carbon capture or carbon storage practices |
| Increasing shade/coffee tree density   | Addition of nitrogen fixing plants                               |
| Addition of nitrogen fixing plants   |  |
| Integrated water management  |  |
| Reduction of erosion risk with terracing or pits for retention of organic material |  |
| Methane avoidance from biomass decay   |  |
| Methane avoidance through composting   |  |
| Methane recovery in wastewater treatment   |  |
| <b>Processing</b>  |  |
| Fuel switch to less carbon intense fuels (e.g., biofuels)                          |  |
| Energy efficient water pumps   |  |
| Renewable energy production  |  |
| Installation of solar water heaters  |  |
| Light retrofitting   |  |
| Methane avoidance through waste separation   |  |
| Methane recovery in wastewater treatment   |  |
| <b>Transport and distribution</b>  |  |
| Fuel switch from fossil to biofuels  |  |
| Transition to electric vehicle use with right mix of renewable energy              |  |
| Transportation fleet retrofitting  |  |
| Improvements in logistics (e.g., less empty running)                               |  |
| Effective transport strategies and routes with fewer emissions                     |  |

| <b>Roasting and final distribution of coffee</b>   |  |
|--|--|
| Use of renewable or green electricity or in operations and processing  |  |
| Use of innovative or environmentally friendly technologies e.g., economizers   |  |
| Sustainable packaging i.e., replacing single use plastic in packages, recyclable or compostable packaging wherever possible etc. |  |

## Annex III: Examples of Text Claims and Disclaimers

Examples of claims for products containing 100% of segregated 4C Climate Friendly Coffee or 4C Climate Neutral Coffee:

- Contains 100% 4C Climate Friendly Coffee or 4C Climate Neutral Coffee
- Certified 4C Climate Friendly Coffee or Certified 4C Climate Neutral Coffee (from farm to roaster)
- Sustainable coffee certified based on 4C Climate Friendly Coffee or 4C Climate Neutral Coffee sustainability requirements
- Made from 4C Climate Friendly Coffee or 4C Climate Neutral Coffee beans
- Made from coffee beans certified according to Carbon Footprint Add-On requirements
- Coffee is made from Carbon Footprint Add-On certified coffee beans.
- Coffee produced, processed, transported and roasted under climate protection practices
- The coffee in this package originates from climate friendly/neutral sources
- This product originates from a climate friendly/neutral supply chain
- This 4C certified coffee reduces carbon emissions by...
- This 4C certified coffee comes from low carbon/carbon neutral coffee farms

Examples of disclaimers for products containing less than 90% (but a minimum of 30%) of segregated 4C certified coffee:

- Contains over 75% 4C Climate Friendly Coffee or 4C Climate Neutral Coffee certified coffee
- 30% certified 4C Climate Friendly Coffee or 4C Climate Neutral Coffee
- 45% sustainable coffee meeting Carbon Footprint Add-On requirements
- With currently 50% certified 4C Climate Friendly Coffee or 4C Climate Neutral Coffee, we're working towards using 100% 4C certified coffee by (year)
- We are committed to reach 100% certified 4C Climate Friendly Coffee or 4C Climate Neutral Coffee, currently using 80%
- Product contains 4C Climate Friendly Coffee or 4C Climate Neutral Coffee

## Annex IV: Logo Colour Guide

The 4C logo is available in different digital formats and in RGB, CMYK, positive and negative color schemes. The logos should preferably be used in the colour version. If this is not possible due to optical or graphical reasons, the black or white version can be used. Proposals to use the logo in any other colours should first be approved by 4C.

### 1. Colour-version



- a. Orange (CMYK: 0 75 86 0; RGB: 235 90 43; Hex: #eb5a2b)
- b. Light green (CMYK: 53 0 55 0; RGB: 133 196 143; Hex: #85c48f)
- c. Dark green (CMYK: 80 29 57 42; RGB: 30 97 85; Hex: #1e6155)
- d. Light blue (CMYK: 100 32 0 28; RGB: 0 125 183; Hex: #007db7)
- e. Dark blue (CMYK: 100 42 0 43; RGB: 0 85 146; Hex: #005592)

### 2. Black-version (100%)



### 3. White-version (invers)

