World-Climate Farm

Standard and guideline for the calculation, validation and verification of greenhouse gas balances on farms and in farm groups.

Developed by Carbon Standards International, Research Institute of Organic Agriculture und Ithaka Institute for climate strategies, 2022 – Version 2.0 (23. Oktober 2022).

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Table of contents

1. Summary

The World-Climate Farm Standard (WCFS) supports farmers and farm groups in recording and calculating greenhouse gas emissions and carbon sinks (C-sinks) of their farm, as well as in developing and implementing emission-reducing measures. The procedure is based on the ISO 14064-1 standard and takes into account the current guidelines of the Intergovernmental Panel on Climate Change (IPCC).

The WCFS enables the comparison of Climate Balances between different farms and is intended to show potentials for improving the results for the individual farm or farm group. For this purpose, the standard defines the most important climate-relevant processes as well as their calculation bases and system boundaries.

In order to draw up the carbon footprint, additional farm-specific data is required in addition to the usual farm data (e.g. areas, zoning, production directions, livestock and products produced). The greenhouse gas balance is then calculated and also presented graphically in the various subject areas. The user should also set his goals for improving his greenhouse gas balance and initiate concrete measures. Both the measurement and a successful improvement of the greenhouse gas balance are rewarded with the World-Climate Farm Label, and the farm receives a certificate. Depending on the status of the farm, three different labels are used:

- "CO2 evaluated" - first year when the balance has been calculated
- "CO2 reduced" - subsequent years when the farm implements its reduction plan
- "Climate neutral" - if the farm has achieved a neutral greenhouse gas balance

The calculation procedure is designed to be as efficient as possible for the farm or group of farms. The project partner prepares the farm for data collection in the World-Climate Farm Tool (WCFT). Based on this, the farm manager adds the necessary data for the calculation of the greenhouse gas balance. The project partner's experts usually check the basic data during an on-site visit and then calculate the carbon footprint. An independent Validation and Verification Body (VVB) approved by Carbon Standards International (CSI) validates the data and issues the necessary certificates.

2. Glossary

The World-Climate Farm certification system consists of a tripartite structure with the following three entities: (1) farm or group of farms; (2) project partner; (3) international validation and verification body.

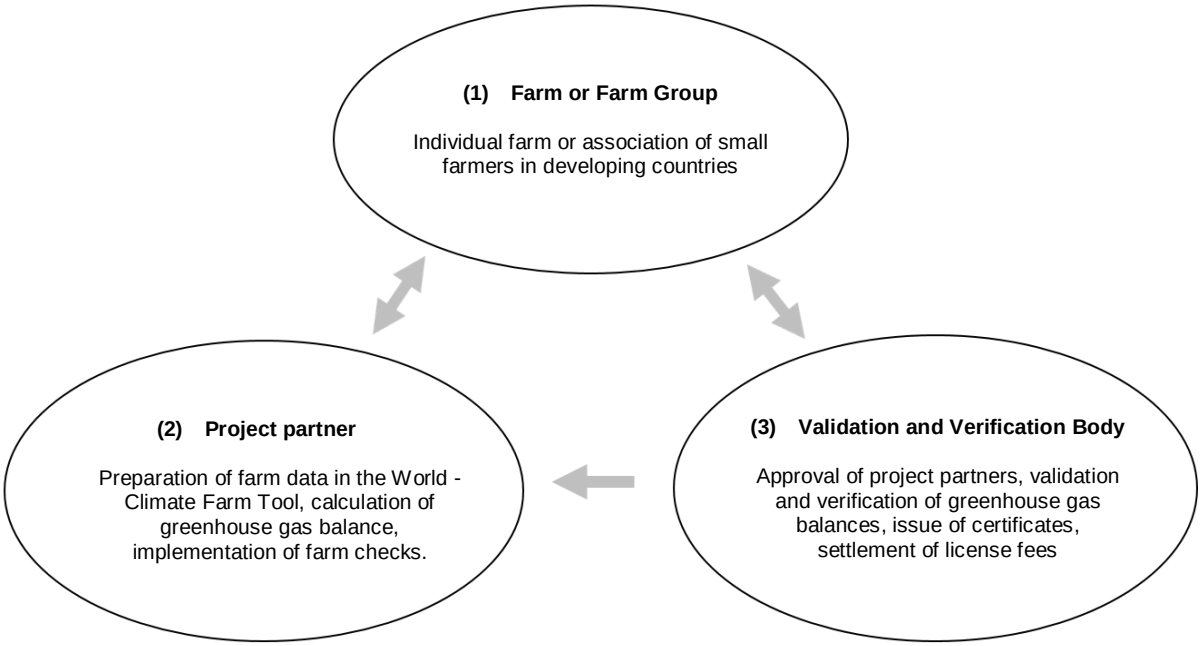

Figure 1: Certification system

The glossary contains a description of the terms used in the standard:

Table 1: Glossary

Term	Description
CSI	Carbon Standards International AG
Standard developers and Standard designer	The World-Climate Farm Standard was developed by Carbon Standards International AG (CSI), the Research Institute of Organic Agriculture (FiBL) and the Ithaka Institute for Climate Strategies (Ithaka) and is continuously developed by them. The World-Climate Farm Standard is owned by Carbon Standards International AG and can only be used with a licence agreement by recognised validation and verification bodies (VVB) and by project partners. Carbon Standards International AG organises the approval process for the VVB.
WCFS	World-Climate Farm Standard - this standard with the associated guidelines for calculating the greenhouse gas balance.
WCFT	The World-Climate Farm Tool is an online IT solution with which the data for climate accounting is collected, the results calculated and summarised for evaluations.
WCFL	World-Climate Farm Label - is the logo and trademark that can be used to award farms if they have a valid licensing agreement with CSI

	and a valid certificate from a certification/validation body accepted by CSI.
Validation and Verification Body (VVB)	The Validation and Verification Body is responsible for the accreditation and training of project partners, the validation and verification of greenhouse gas balances, the issuing of certificates and the settlement of licence fees. The Validation and Verification Body is accredited and qualified by Carbon Standards International for this work.
Project partner	The project partner supervises the farm or group of farms and is responsible for preparing the farm data in the World-Climate Farm Tool. He calculates the greenhouse gas balance and carries out farm checks. The project partner is approved and qualified by the VVB for this work.
Farm	Economic unit of an agricultural enterprise with one or more locations. The farm management is identical for this economic unit.
Farm group	Association of small farmers in developing countries, based on an internal management system with clearly defined processes.
Climate Balance	The Carbon Footprint of a farm is described in the standards as Greenhouse Gas Balance or Climate Balance
Carbon dioxide emissions (CO2)	Climate-relevant CO2 emissions result primarily from the combustion of fossil fuels. In agriculture, this includes emissions from agricultural machinery and farm vehicles. In a holistic Climate Balance, emissions from journeys with non-farm vehicles, from the recycling of waste of fossil origin and many other processes must also be taken into account.
Methane emissions (CH4)	The majority of methane emissions on farms occur in the digestive tract of ruminants. The outgassing of unfermented farmyard manure and leaks in gas pipes are further sources of methane. Leakages are usually not relevant on farms because no methane is carried in pipelines. Methane has a higher greenhouse gas potential than CO2: if the period of 100 years after emission is considered, a climate effect can be observed - taking into account the gradual decomposition to CO2 - which corresponds to 28 times the corresponding CO2 emission.
Nitrous oxide emissions (N2O)	Nitrous oxide emissions result, for example, from the outgassing of farmyard manure. Although this emission is small in terms of mass compared to the other gases, it is highly relevant due to its higher

	global warming potential - 298 times higher than that of CO2 over a 100-year period.
Reduction measures	Greenhouse gas (GHG) emissions can be counteracted with various reduction measures. This includes emission-reducing measures, C-sinks and external compensation.
Emission-reducing measures	The aim here is to reduce the GHG emissions generated on the farm.
C-Sink	Carbon sinks describe the short- or long-term storage of organic material on the farm. C-Sink can be used to compensate for GHG emissions.
Short-term C-Sink	Short-term C-sinks consist of the deposits of organic material in the soil (humus), woods, trees and hedges.
Long-term C-Sink	Long-term C-Sink are those carbon fractions of e.g. plant carbon or rock flour carbonates that have a persistence of at least 100 years.
Emission certificates	GHG emissions can be offset with purchased emission certificates. This is the third priority of the reduction measures.
GHG declaration	The GHG statement is composed of the linking of assumptions, methods and limitations with the climate-relevant data of the farm.
Net emissions	GHG emissions reduced through (a) own realised carbon sinks and (b) approved own purchased carbon credits
Tons of CO2 equivalents (t CO2eq)	Standardised unit of mass for greenhouse gases: 1 t CO2eq methane or nitrous oxide causes the same climate effect as 1 t CO2 in the defined period (100 years, unless otherwise stated)
ISO 14064	The ISO 14064 standards consist of 3 guidelines and were developed for the accounting of greenhouse gas emissions and the development of measures to reduce them. The standards can be applied to different systems, organisations and events. ISO 14064-1 requires that the user of the standard, on the one hand, describes the assumptions, calculation methods and their limitations, and on the other hand, provides the input data and information for the balancing. The data basis is validated during the on-site inspection. The description of the reduction targets is verified by the VVB. The WCFS is based on this ISO standard and is specified for use on farms.

3. Introduction

The consequences of advancing climate change can be observed in various areas around the world. In the context of climate change, agriculture plays an ambivalent role, acting as an affected party, as a cause, but also as part of the solution:

- Greenhouse gas emissions are leading to rising temperatures and causing extreme weather conditions. Droughts and heavy precipitation are becoming more frequent and are a burden on agricultural soils and crops.
- Greenhouse gas emissions from agriculture include, for example, methane emissions from cattle farming and the outgassing of farmyard manure. The use of fossil fuels in agricultural machinery also contributes to climate-relevant CO2 emissions.
- Carbon sequestration on the farm creates short- or long-term carbon sinks (C-sinks). By certifying these sinks, existing greenhouse gas emissions can be offset. This supports the farm to better mitigate future climate change impacts.

The calculation of Climate Balances is becoming increasingly relevant for agriculture. For farms, it offers the opportunity to make processes more climate-friendly and to compensate for the remaining emissions by means of C-sinks. Through a realistic, generally valid, holistic and scientifically based standard, the farm receives information about its Climate Balance. At the same time, the potential for continuous improvement of the Climate Balance is revealed. If reduction measures are successfully implemented, the farms receive a corresponding certificate and label.

The food industry and food retailers are also increasingly interested in the climate performance of their suppliers. It can be assumed that the prices for agricultural products will in future also be based on the quality criterion "Climate Balance" or that customers will take this into account when making their purchasing decisions. This gives the farmer the opportunity to achieve additional revenues with targeted measures in the area of climate protection.

The public interest and the defined climate targets are leading government agencies to reward efforts and successes in the area of climate protection on the farm as well. It is to be expected that this will quickly become concrete and that support payments for the reduction of GHG emissions and the active creation of carbon sinks can also be expected here.

4. Validation and verification

Validation and verification consists of an annual data collection and an annual on-site inspection cycle. Once they have successfully completed this process, the farm receives a certificate from an approved VVB that is valid until 31 December of the following year. Exceptions to the annual on-site

inspection may be approved by the VVB in exceptional cases for farms where no positive or negative changes are identified in the data collection. However, on-site inspections must be carried out at least in the first year and every third year of the granted certification.

The VVB can choose a project partner who can take on the following tasks in particular: Preparation of operational data in the WCFT, operational controls and calculation of greenhouse gas balance. The project partner is contractually bound to the VVB and to confidentiality.

The companies are obliged to keep appropriately detailed records of the Scope 1, 2 and 3 data collected in the WCFT and to present them during an inspection. During the inspection, the accuracy and plausibility of the data provided in the WCFT is checked. All information disclosed by the companies will be treated confidentially by the VVB, the project partner and the CSI.

4.1 Process of validation and verification

The validation and verification process runs according to the diagram below:

1. Assumptions, methods and constraints are specified in the WCFS and WCFT and verified by the VVB
2. The climate-relevant data are recorded by the project partner and the farm in the WCFT and validated by the VVB.
3. Once points 1 and 2 have been completed, the Climate Balance can be calculated. The VVB issues the necessary certificates.

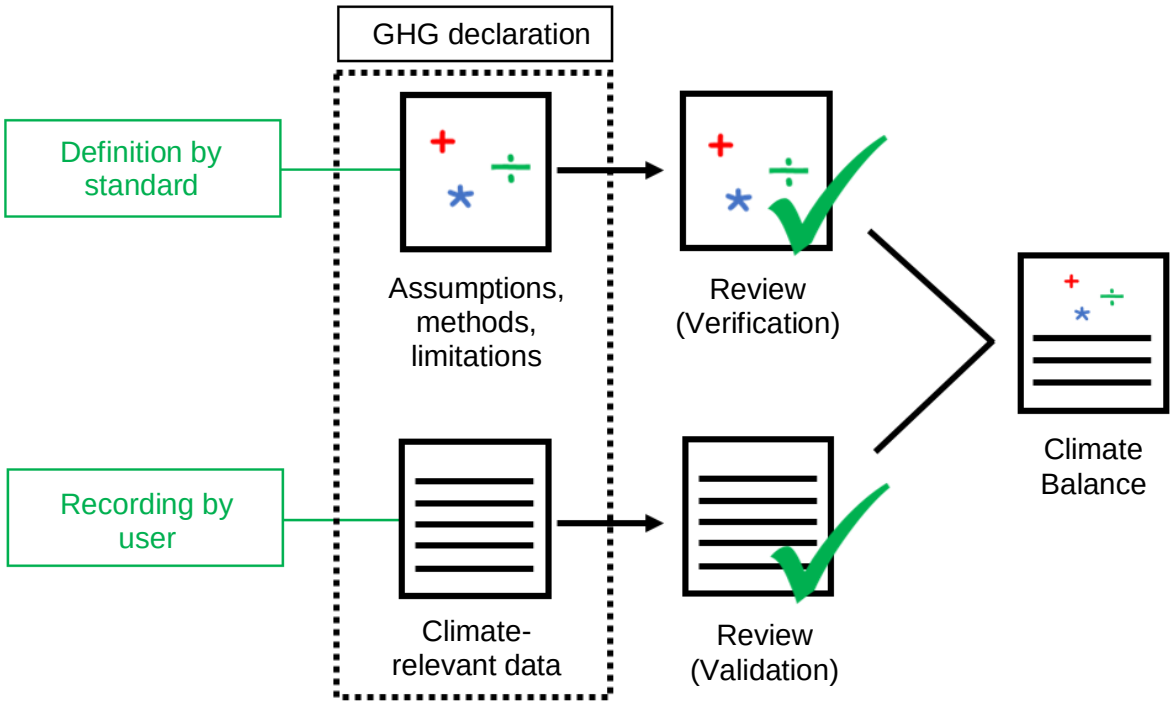

Figure 2: The path to a Climate Balance, verification and validation

The calculations of the Climate Balances usually take place annually and cover the operational processes and production of a year. The certificate issued annually by the VVB is also available to the farm as proof of quality. In the first year, the company receives the "CO2 evaluated" certificate. In the following years, the VVB checks whether the reduction measures have been successfully implemented. If the implementation is successful, the label "CO2 reduced" or "climate neutral" can be awarded from the first subsequent year - the evaluation of the first year ("base-year") serves as a reference. The "climate neutral" label can also be awarded in the first year if the farm achieves the corresponding results in the greenhouse gas balance.

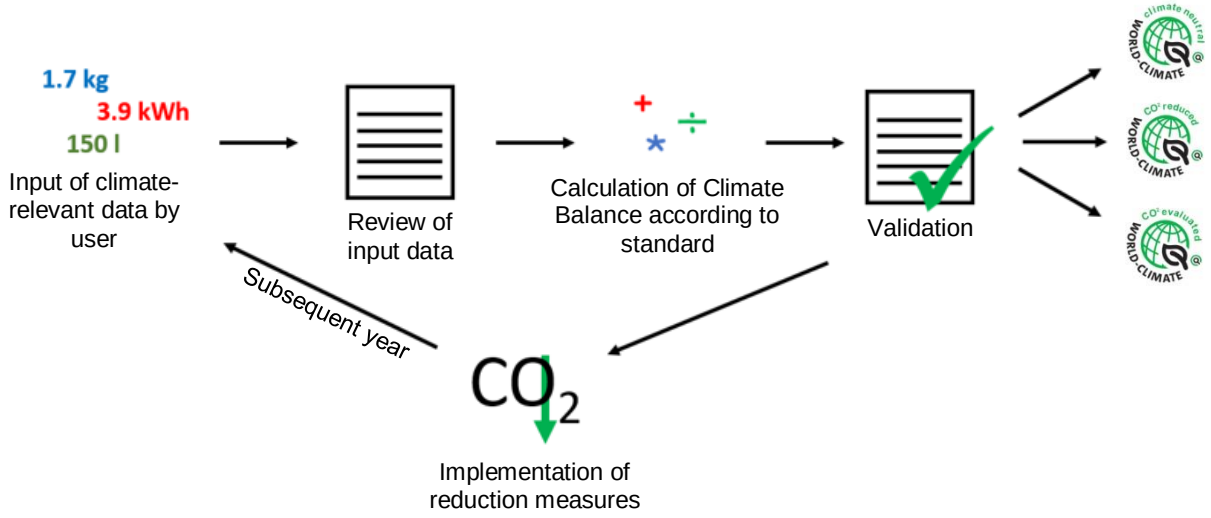

Figure 3: Reduction targets, tests and labels

4.2 Procedure in the event of infringements and sanctions

The VVB decides on the severity of the violation and the corresponding sanction level. The weakest sanction is a warning with a deadline to remedy the deficiency. The strongest sanction is the withdrawal of an operation or the termination of the contract with payment of a contractual penalty and possible damages as well as the publication of the decision. Appeals against decisions of the VVB must be addressed to the VVB. Appeals against enforcement decisions on the WCFS shall be dealt with by the independent appeal body of the CSI.

4.3 Group certification

Under certain conditions, farms can be grouped together. The model is usually applied in developing countries.

In the case of group certification in developing countries, the individual farms are checked via a so-called Internal Control System (ICS), which is then in turn checked by a VVB. So that each group member does not have to enter its data individually into the system, this data collection can be done collectively in the WCFT. More details can be found in "Appendix 5 Group Certification Requirements".

4.4 Contractual and control obligation

The farms that want to be verified and validated according to the WCFS must participate in the verification and validation procedure and be regularly checked for compliance with the guidelines. For this purpose, the farms conclude an agreement with a CSI-recognised VVB. In the case of groups of farms (see above), a contract must be concluded between the VVB and the management of the group, which regulates the responsibilities within the group and with regard to the Internal Control

System (ICS). The farms are authorised to use the World-Climate Farm label through a licence agreement with CSI. The contract also regulates the use of the label in sales and trade. Anyone wishing to use the label for other purposes must conclude a separate brand use agreement with the CSI.

4.5 Validation and verification bodies (VVB)

The authorisation of VVBs is conducted through a contract with CSI. VVBs must be authorised by CSI to provide their validation and verification services. The authorised VVBs are published on the CSI website. The VVB is trained by CSI to implement the standard requirements and is audited annually. The basis for the authorisation of the VVB is the accreditation according to 14064-3 and 17029/14065 (current valid version) by a recognised accreditation body. For approval, the VVB can also be in an ongoing accreditation procedure.

5. Basics of the GHG declaration

The GHG statement is composed of the linkage of the following areas:

- Assumptions, methods and limitations: These are governed by this standard and are pre-audited and accepted by the VVB.
- Climate-relevant data: These refer to the climate-relevant data described in chapter "6. Processes". They are recorded by the user and checked by the VVB.

The result of the GHG statement is the Climate Balance of the farm. In the following chapters, the different areas of the GHG statement are discussed in more detail.

5.1 System boundaries

When calculating the Climate Balance, those GHG emissions and C-Sink are represented which occur on the farm. Based on this consideration, the system boundary is set as follows:

Scope 1 and Scope 2 emissions are fully attributed to the balanced operation. Scope 3 emissions are freely selectable at farm level and are determined by the VVB in cooperation with the farm or farm groups. The WCFS provides a recommendation and focuses on hotspots of Scope 3 emissions in agricultural processes (see chapter "6.3 Scope 3 - Other indirect emissions").

If the farm is a family business, the private consumption of the operators is not included in the Climate Balance. Business trips with non-business vehicles are recorded and taken into account accordingly in the calculations. Processes with negligible climate impacts are not quantified but covered by the margin of safety (see chapter "6. Processes"). Further details on the system boundary can be found in the appendix.

5.2 Selection of the processes

When selecting the processes, the scopes of ISO 14064-1 were taken as a basis. They are summed up into the following scopes:

- Scope 1 - direct emissions: In this chapter, all greenhouse gas emissions are accounted for that are generated directly on the farm.
- Scope 2 - indirect emissions: Summarizes all indirect greenhouse gas emissions resulting from the provision of energy for the farm.
- Scope 3 - other indirect emissions: Summarizes all other indirect greenhouse gas emissions resulting from operational activities.

In addition, C-sinks of the farm are still shown as a separate chapter

5.2.1 Non-quantified processes

Processes whose climate effect can be assumed to be relatively small are not quantified. Instead, these processes are covered by the general margin of safety (see chapter "5.5 Margin of safety"). As these can differ greatly due to different circumstances in the various countries, regions, projects, etc., a blanket coverage of non-quantified processes is not reasonable. If they are not regulated in the country annex 4, these are developed by the company together with the VVB. It must be ensured that the GHG emissions of the non-quantified processes do not exceed 5% of the GHG emissions that occur at the farm. This must be checked by the VVB on a random basis in order to adjust the margin of safety if necessary.

5.3 Quantification of the processes

The shifting processes are supplemented with climate-relevant data by the farm or farm group together with the project partner. Often there is already data verified by a control or certification body, which can be used for the calculation.

5.3.1 Level of assurance - processes

During the validation of the operational data, the accuracy, reproducibility and indication of origin of the data is checked. The level of assurance of the climate-relevant data is determined based on the type of data procurement and is set by the VVB. A distinction is made between three levels:

- High level of assurance: Verified data from traceable sources, e.g. invoices, delivery notes or already certified data.
- Medium level of assurance: Measured values, e.g. leakage, felled wood
- Low level of assurance: Estimated values, e.g. farmyard manure discharge

The higher the level of security, the lower the percentage of the margin of safety and vice versa (see chapter "5.5 Margin of safety").

5.4 GHG factors

The factors used to calculate greenhouse gas emissions are taken from scientific publications and kept up to date by the CSI together with the Ithaka Institute and the Research Institute of Organic Agriculture Switzerland (FiBL).

5.4.1 Level of assurance - GHG factors

The respective level of assurance is specified for the deposited process factors. This is based on the origin of the source and is determined by the CSI. A distinction is made between three levels:

- High level of assurance: values from scientific publications
- Medium level of assurance: values from other recognised publications, e.g. from government offices.
- Low level of assurance: Assessments

The higher the level of security, the lower the percentage of the margin of safety and vice versa (see chapter "5.5 Margin of safety").

5.5 Margin of safety

The degree of uncertainty (in factors and operational data) and unquantified processes make it necessary to integrate a margin of safety in the system. This guarantees that the results of the Climate Balances are not underestimated and can be kept as conservative as possible.

The starting point of the margin of safety is 5% of all non-CH4 emissions. It reflects the unquantified processes and assumes that both the processes and the operational data have a high degree of certainty. The lower the level of certainty, the higher the attributed margin of certainty. Here, the average level of assurance of the factors is calculated on the part of the CSI, that of the operational data on the part of the VVB. A medium level of security for the processes combined with a medium level of security for the factors results in a 15% security margin.

Table 2: Margin of safety

processes / factors	high	medium	low
high	5%	10%	15%
medium	10%	15%	20%
low	15%	20%	30%

5.6 Calculation of the Climate Balance

To calculate the Climate Balance, the climate-relevant data collected in the processes are multiplied by the GHG factors. The effect of all greenhouse gases on the climate (climate impact) is indicated by the unit of measurement "t CO2eq". The greenhouse gases Carbon Dioxide (CO2), Methane (CH4) and Nitrous Oxide (N2O) are considered here.

Table 3GHG emissions

Greenhouse gases	Greenhouse gas potential (CO2eq)
Carbon dioxide (CO2)	1
Methane (CH4)	28
Nitrous oxide (N2O)	298

6. Processes

The processes are subdivided into Scope 1, Scope 2 and Scope 3. In addition, short- and long-term C-Sink are listed.

6.1 Scope 1 - Direct emissions

In this chapter, all greenhouse gas emissions that occur directly on the farm are accounted.

6.1.1 Fuel consumption

For the calculation of fuel consumption, the thermal use of fuels in vehicles, agricultural machinery and other operational applications is considered. For this purpose, the fossil fuel consumption of all processes of stationary equipment (generators, boilers, grinders, dryers, irrigation, etc.) and mobile equipment (tillage, sowing, harvesting, transport, etc.) shall be specified. In order to provide these values with a high degree of certainty, they should be supported by documents (invoices, delivery notes, logbook, etc.) that allow conclusions to be drawn about actual consumption. If it is not possible to distinguish between private and business fuel consumption on a farm with the help of the documentation, a realistic estimate by the farm manager is necessary. In this case, the private consumption must be deducted from the total fuel consumption and a justification of the assumption must be given. If a check by means of existing documentation is not possible, a low degree of certainty is assumed.

6.1.2 Thermal biomass utilization

6.1.2.1 Biomass furnace:

Biomass firing is considered climate neutral. In order to present the overall process of the farm in a holistic way, it is also necessary to specify the kilowatt hours/year produced. For this, the biogenic

consumption of all processes and plants (heating, CHP, etc.) must be specified. In order to provide these values with a high degree of certainty, they should be supported by documents (invoices, delivery notes, protocols, etc.) that allow conclusions to be drawn about actual consumption. If it is not possible to distinguish between private and farm biomass consumption on a farm with the help of the documentation, a realistic estimate by the farm manager is necessary. In this case, the private consumption must be determined and deducted from the total consumption. In addition, a justification of the assumption must be given. If a check by means of existing documentation is not possible, a low degree of certainty is assumed.

6.1.2.2 Biomass gasification:

If EBC-certified biochar is produced in the course of biomass gasification, the heat and production generated via the C-sink of the biochar is to be regarded as climate-neutral. Should it be a plant that does not have EBC certification, the emission values must either be analysed or requested from the producer. In order to present the overall process of the farm in a holistic way, it is also necessary here to indicate the kilowatt hours/year produced. In order to provide these values with a high degree of certainty, they should be supported by documents (invoices, delivery notes, protocols, etc.) that allow conclusions to be drawn about the actual production. If it is not possible to distinguish between private and operational consumption on a farm with the help of the documentation, a realistic estimate by the farm manager is necessary. In this case, private consumption must be determined and deducted from total consumption. In addition, a justification of the assumption must be given. If a verification by means of existing documentation is not possible, a low degree of certainty is assumed.

6.1.2.3 Pyrolysis:

Should EBC-certified Biochar be produced within the pyrolysis process, the heat and the production via the C-sink of the Biochar shall be considered climate neutral. Should it be a plant that does not have EBC certification, the emission values must either be analysed or requested from the producer and made available. In order to present the overall process of the farm in a holistic way, it is also necessary here to indicate the kilowatt hours/year produced. In order to provide these values with a high degree of certainty, they should be supported by documents (invoices, delivery notes, protocols, etc.) that allow conclusions to be drawn about the actual production. If verification by means of existing documentation is not possible, a low degree of certainty is assumed.

6.1.2.4 Biogas plant:

Biogas plants are classified as climate neutral for the pilot phase. Methane leaks (CH4 leakages) must be accounted for separately. In order to present the overall process of the agricultural operation in a holistic manner, it is also necessary to specify the kilowatt hours/year produced here. In order to provide these values with a high degree of certainty, they should be supported by documents (invoices, delivery notes, protocols, etc.) that allow conclusions to be drawn about actual production. If verification by means of existing documentation is not possible, a low degree of certainty is assumed.

6.1.3 Greenhouse

If it is possible to inject produced CO2 (e.g. from biomass gasification) into greenhouses on the farm, this must be indicated.

6.1.4 Digestion in animal husbandry

In the field of animal husbandry, the digestion of ruminants produces significant amounts of methane emissions. For this reason, the average number of all animals on the farm over a year should be recorded. CO2 emissions from animal husbandry are considered climate neutral. Special attention should be paid to the areas of husbandry and feeding (especially the addition of concentrated feed). If these are certified data or can be provided by the farm, a high degree of certainty is assumed.

6.1.5 Slurry

The storage and spreading of slurry generate relevant quantities of emissions. In order to quantify these, the own production, supply, removal, utilisation and spreading must be recorded and documented. In order to present the calculation in detail, additional information on water content, N content, as well as application method and treatment of the slurry should be provided.

6.1.6 Manure

The storage and spreading of manure generate relevant quantities of emissions. In order to quantify these, the own production, supply, removal, utilisation and spreading must be recorded and documented.

6.1.7 Compost

Due to the largely anoxic decomposition (large windrows, little turning), relevant amounts of methane are produced during the biological decomposition of the biomasses, which are reported separately as CH4 emissions in the balance sheet. The CO2 emissions are considered neutral. Aerobic compost production is assumed to be climate neutral (minus diesel consumption for turning). It can be assumed that the low methane emissions that still occur are compensated by the

high C-stability of the compost produced in this way and thus by a significant C-sink value, which is not taken into account here. C sequestration is accounted for by humus growth in the field.

6.1.8 Digested slurry (farmyard manure), digested manure (farmyard manure), digested liquid fertilizer (recycled manure), digested solid fertilizer (recycled manure)

Data on fermented farmyard and recycled manure are collected in order to capture the processes on the farm holistically. The GHG factor of fermented products is neglected for the time provisionally.

6.2 Scope 2 - Indirect emissions

All processes listed in Scope 2 summarise those GHG emissions that arise from the provision of energy for the farm.

6.2.1 Electricity production

Electricity production by the farm's own solar and wind plants, pyrolysis plants and biogas plants is recorded as climate neutral. However, no further emissions saved (e.g. by replacing coal-fired electricity) are included in the Climate Balance. Only the carbon footprint of purchased electricity is included in the farm's Climate Balance.

6.2.2 Heat production

No emissions relevant to the balance are caused by heat production from biomass and solar energy. However, the amount of on-site heat production is recorded and listed in the reporting. Heat production from in-house solar and wind plants, pyrolysis plants and biogas plants is not directly included in the Climate Balance. The production through the above-mentioned technologies is considered climate-neutral. Heat production through renewable energy is deducted from the total heat consumption, thus reducing the amount of heat that is purchased or produced by burning fossil fuels. In the balance of the farm, only the carbon footprint of purchased heat and heat produced by fossil fuels is recorded.

6.2.3 Electricity and heat consumption

Electricity and heat consumption includes the greenhouse gas emissions that result from the consumption of purchased electricity and heat as well as from the combustion of fossil fuels. These depend on the respective mix as well as the fuels used and can have very different compositions. If the information on the carbon footprint of the purchased electricity or heat is not shown by the provider (e.g. invoice, business papers, etc.), an average value for the respective country is assumed.

If it is not possible to distinguish between private and operational electricity and heat consumption on a farm with the help of the documentation, a realistic estimate by the farm manager is necessary. In this case, the private consumption must be deducted from the total consumption and

a justification for the assumption must be given. If a verification by means of existing documentation is not possible, a low degree of certainty is assumed.

6.3 Scope 3 - Other indirect emissions

Summarises all other indirect greenhouse gas emissions that arise from operational activities. This standard focuses on hotspots for Scope 3 emissions in agricultural processes. If the emissions/CO2 footprints of the upstream supplier are known (e.g. emission-reducing or climate-neutral production), these values should be applied.

6.3.1 Non-agricultural emissions

6.3.1.1 Logbook

All business trips (trade fairs, sales appointments, etc.) that are made with non-business vehicles such as trains, rental cars, public transport, taxis and aeroplanes should be recorded in the logbook. The resulting greenhouse gas emissions are attributed to the farm.

6.3.1.2 Transport of goods

When goods are transported within the system boundary (e.g. to company-owned sales and processing points) by transport companies, the greenhouse gas emissions of the transport company are taken into account. For this reason, the type of vehicle (car, lorry, ship, plane, etc.) and the distance travelled must be specified. Emissions from transport from the farm to the customer are not included in the Climate Balance, as these should be allocated to the customer according to the standard guidelines. Transport with own vehicles within the system boundary is accounted for via fuel consumption in Scope 1.

6.3.1.3 Packaging materials

Relevant quantities of emissions are generated during the production of packaging material. The company has a significant share in the GHG emissions due to the material selection decisions and can therefore also indirectly implement savings potentials there. For this reason, information on the raw materials used, including the quantity, is necessary and must be submitted to the VVB.

6.3.1.4 Waste generation

The generation of waste produces significant emissions over which the farmer has a direct influence. In order to include this in the Climate Balance, the type and quantity of waste generated on the farm must be specified.

6.3.2 Plastics in field use

Purchased plastic products used in the field, such as cover sheets, mulch tarpaulins, irrigation hoses, greenhouse film, silage film, etc., must be declared. In addition to the quantities used, information on the material composition must also be provided.

6.3.3 Seed, litter, mulch, feed

In this chapter, purchased seed, litter, mulch material and feed must be listed. In addition to the purchased quantity, the country of origin of the various products must also be indicated here. The production of purchased seed, litter, mulch and fodder shall be credited to the farm. The transport kilometres travelled (by ship and road) per tonne are also taken into account.

6.3.4 Mineral fertilisers

The total amounts of mineral fertilisers used must be reported as follows:

- Name of the mineral fertiliser
- Composition of the mineral fertiliser (nitrogen, phosphorus and potassium)
- Amount of mineral fertiliser used

6.3.5 Crop protection products

The total amount of plant protection products used must be declared as follows:

- Name of the plant protection product
- Quantity of the plant protection product.

6.4 C-Sink

The WCFS distinguishes between short-term and long-term C-Sink (see also Annex 1). Growing biomass (forests, trees, hedges) and the storage of organic material in the soil (humus) are considered short-term C-Sink. As a long-term C-Sink, the soil application of plant carbon is seen as an example:

6.4.1 Growing biomass

The farm shall provide information on its growing perennial biomass. In this respect, the number of high and low trunk trees, the forest area (<20 years and ≥20 years) and the length of the hedges standing on the farm shall be provided. In addition, the use of the growing biomass shall also be submitted to the VVB.

6.4.2 Humus balance

The farm has another possibility to build up short-term C-sinks by building up humus. For this purpose, there is the possibility in 2022 to select measures that are scientifically proven to lead to a change in the humus content. Information must be provided on the following points:

- Arable land converted to permanent grassland in the last year
- Use of green manure on the farmland

- Arable land with catch crops
- Arable land with undersowing in maize and/or cereals
- Area of perennial artificial meadows in the crop rotation
- Areas in which cereal straw and/or rape straw have been incorporated
- Arable land cultivated with no-till farming
- Arable land cultivated with mixed crops
- Arable land that has been cultivated with conservation tillage methods
- Arable land that has been ploughed deeper than 10 cm

If the farm is part of an existing humus cultivation project, it has the possibility to provide information about these measurements.

6.4.3 Biochar as a C-Sink

Here, a statement of the amount of biochar used on the farm is required. It is not taken into account whether it was added to silage, feed, slurry, compost or mixed with fertilisers. It is important to indicate the amount of plant carbon applied in dry matter. Furthermore, an indication of the plant carbon produced on the farm (in dry matter) and the EBC certified C-Sink potential (in %) is relevant. The C-Sink can be certified and credited by the VVB.

7. Reduction of GHG emissions

7.1 Basics

Within 3 months after the calculation of the baseline data, the farm defines reasonable measures for the reduction of greenhouse gas emissions with a corresponding time schedule. The progress of the reduction should be evident every year and be validated by the VVB in the annual review.

When defining the measures, the company is supported by the project partner or the VVB. The feasibility and economic efficiency of the measures are taken into account. The company undertakes to implement the proposed measures within a defined timetable. The implementation is verified by the VVB and - if the measures or the schedule are not ambitious enough - discussed with the company: The farm measures and documents the climate-relevant processes that are affected by the measures in accordance with the specifications of the WCFS. When assessing the emission-reducing measures, the Climate Balance in the first year serves as the reference scenario (referred to as the "base-year" in the ISO standards).

7.2 Reduction measures

GHG emissions can be counteracted with various reduction measures. This includes emission-reducing measures, C-sinks and external compensation.

7.2.1 Emission-reducing measures

On farms, there are various ways to reduce GHG emissions. GHG emissions can be reduced through various emission-reducing measures. In addition to the use of equipment and processes, the reduction or replacement of fossil materials and energy sources with renewable alternatives also contributes to improving the Climate Balance. This option must always be given top priority; only after implementing emission-reducing measures can emission certificates be obtained.

7.2.2 C-Sink

On farms, there are various possibilities for creating C-sinks. These include managing forests, trees and hedgerows, as well as building carbon reservoirs in the soil with humus or biochar.

A distinction is made between short-term and long-term carbon sinks. In short-term C-Sink (humus, forests, trees and hedges), the sequestered CO2 can be quickly released again over a period of a few years. These sinks can be included in the calculation to compensate for the short-term greenhouse gas effect of methane emissions. Here, the conversion factor between short- and long-term greenhouse gas potential factors must be taken into account (see Appendix). EBC-certified biochar, which can either be produced on the farm or purchased externally, is suitable as a long-term C-Sink.

7.2.3 Purchase of emission certificates

It should become possible to make farms climate-neutral by external compensation of emissions. This is done by purchasing certified emission reductions or C-Sink. For offsetting, only purchases of certificates from those platforms and registries that are deemed trustworthy by the CSI are permitted. These include Carbonfuture, ICROA and various national emissions trading registries, which are published on the CSI website. The company has the possibility to ask the CSI whether a certain registry is considered trustworthy and can therefore be added to the list. It is very important to note here that especially short-term methane emissions can also be compensated very well in inter-operational cooperation between several farms.

7.2.4 Reduction plan

From 2023 onwards, the company has the possibility to calculate different scenarios for the reduction of its GHG in the WCFT. If these are emission-reducing measures, C-Sink or purchased emission certificates that are already recorded in the WCFT, they no longer have to be verified by the VVB. If these are individual measures, they must be verified by the VVB. In both cases, the reduction plan is checked as part of the validation. If the reduction targets are not sufficiently ambitious, the VVB can reject the plan and demand further measures. As a guideline, at least a 5 percent improvement per year should be aimed for. It is at the discretion of the VVB to assess this, taking into account the specific situation on the farm. This is based on experience and comparable farms.

7.2.5 Selection of reduction measures

When selecting the reduction measures, the user must prioritize emission-reducing measures and C-sinks implemented on the farm. Only if the processes for this are not technically or economically feasible, the acquisition of external certificates can be considered as a reduction measure.

7.2.6 Additionality

The balancing in the first year of investigation and the subsequent awarding of the label "CO2 evaluated" serves as a reference state (base-year) for the awarding of the further compensation certificates. During the validation in the following year, additionality is checked; i.e. it is ensured that the reduction of emissions was only made possible by the introduction of the defined measures. Additionality is not guaranteed, for example, if the reduction measures coincide with the closure or significant restructuring of the farm.

However, if certification with the "CO2 reduced" label is rejected after the revalidation due to the lack of additionality, the current Climate Balance can be used again as the reference scenario for the following year.

If the company cannot show any further improvements in a given year, the "CO2 reduced" label can be retained for a year if it can be shown that measures will be taken in the following year to achieve a reduction. In this case, the VVB is required to review the measures during the year and to ensure that they are implemented. If no reduction is achieved for two consecutive years, the right to use the "CO2 reduced" label expires. In this case, the company will be downgraded to the status "CO2 evaluated" or may lose the certification in the following year if no further meaningful reduction measures can be taken.

7.2.7 Exclusivity

The World-Climate Farm Standard is an open system in which the farm can participate in various offset projects. Both in the area of implemented carbon sinks and in the area of reduction of greenhouse gas emissions, various financial incentives and options for compensation will be implementable today and in the future.

The farm or the farm group shall indicate in the annual declaration of operational data which offset projects, if any, they participate in and which measures with which values are financially compensated annually.

Although these values are still shown in the World-Climate Farm Climate Balance, they can no longer be certified as emission reductions or carbon sinks. The VVB checks the participation in such offset projects and ensures that only those services are certified which have not already been booked and settled elsewhere. All carbon sinks certified by VVB are transparently presented in the CSI's Global C-Sink Registry.

8. World-Climate Farm Tool

For optimal and simple application of the WCFS, Carbon Standards International (CSI) offers the World-Climate Farm Tool (WCFT). The data collection and calculation of the Climate Balances proceed as follows:

1. The project partner prepares the operation in the WCFT for the supplementary data collection; as a rule, data already verified by external bodies are used (cantonal offices, control bodies, externally validated calculations on a verified data basis).
2. The farm manager receives the invitation and completes the missing data in the WCFT directly online. A deadline is set for the project partner by which date the data set must be completed.

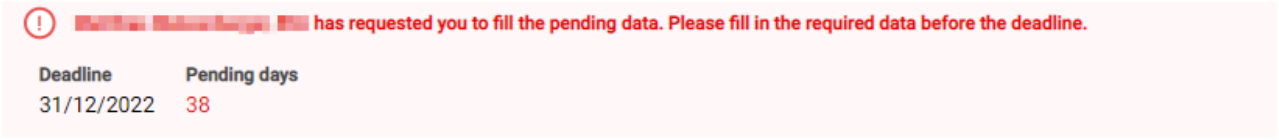

Figure 4: Representation of the deadline

3. The farm manager completes the data collection by pressing the button "Submit data" and thus returns the order to the project partner.

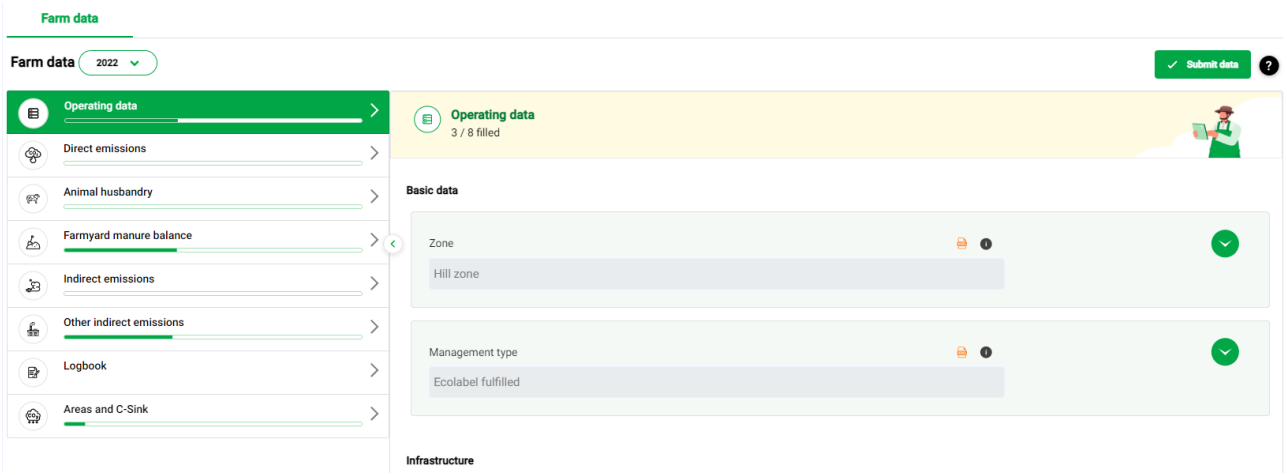

Figure 5: World-Climate Farm Tool

4. The project partner checks the data on the farm and calculates the Climate Balance.
5. The order is passed on to the Validation and Verification Body (VVB). This body issues the certificate. The results are presented in tabular and graphic form and, in addition to showing potential for improvement, also allow anonymous comparisons between companies.

9. Greenhouse Gas Report

The GHG report consists of the Climate Balance, the performance indicators and the mass flow diagram.

9.1 Climate Balance

The result of the GHG declaration is presented in the Climate Balance. Here, CH4 emissions are compensated with short-term C-Sink (conversion factor see appendix). Long-term C-Sink serve as compensation for short- and long-term GHG emissions. This results in the Climate Balance (net emissions). It is available to the farm online in WCFT and also as a print version.

9.2 Performance indicators

In order to be able to compare the Climate Balance of different participating farms, performance indicators are calculated based on the results of the assessment. These include:

- Net emissions from the calculated Climate Balance (in tCO2eq/year)
- Net emissions per agricultural area (in tCO2eq/ha/year)
- Net emissions per food produced (in tCO2eq/kcal/year)
- Net emissions from fuel consumption (in tCO2eq/year)

The performance indicators are published in the WCFT in anonymised form. The median value of all farms is also given. For each performance indicator, the calculated values of the farms are presented graphically as a histogram.

9.3 Mass flow diagram

In the mass flow diagram, imported and exported goods of the farm - e.g. seeds, feed, fertilisers and foodstuffs, the GHG emissions and C-Sink generated are shown graphically. The diagram allows comparisons to be made between different farms.

10. Certificates and report

The verification of the WCFS, as well as the validation of the users' input values, are carried out by a Validation and Verification Body recognised by the CSI. The certificates and balances issued by the VVB can be viewed directly in the WCFT and exported if required.

11. Award

If a farm receives a corresponding certificate, it can use the following World-Climate Farm Labels to promote the farm and the products produced, depending on the status of the certificate, regardless of the farm's progress:

Table 4Labels

Label	Description
	The company achieves the status " CO_2 evaluated" in the first year after a Climate Balance has been calculated and verified. If a farm cannot achieve a reduction, it is downgraded to this status again. (see chapter "7.2.6 Additionality")
	The farm can achieve the status "CO_2 reduced" from the following year after the defined GHG reduction plan has been successfully implemented and validated by the VVB.
	A company achieves the status of "climate neutral" if its Climate Balance is ≤ 0 t CO_2eq.

The use of the labels and trademarks must comply with the CSI design manual, which is published on the website.

The labelling of products is possible for the farm or group of farms for all products produced. For processing and trading companies as well as in the retail trade, the label can be used if the farms or groups of farms are certified according to the WCFS and the companies in the supply chain are also under the control and certification procedure according to the World-Climate Farm Standard. In the market introduction phase, when possibly not all farms or groups of farms are certified yet, the "mass balance" system can be applied for the award during a transitional period of 2 years. Requests for the application of the mass balance system and its implementation are reviewed and approved by Carbon Standards International.

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Appendix 1

System boundaries

Greenhouse gas emissions

Source		Gas	Included?	Explanation
Baseline	Fuel consumption (diesel, petrol, gas)	CO_2 eq	Yes	emissions are directly linked to agricultural activity. Private consumption is estimated and deducted.
	Thermal biomass use	CO_2 CH_4 N_2 O	No	Biomass combustion: For the pilot version of the tool, heating with biomass - according to the definition by FOEN - is set as climate neutral. For future versions, emissions from biomass combustion will be included and corresponding emission analyses will be requested. Biomass gasification: If biochar is produced, the heat via the C-Sink of the Biochar is to be considered climate neutral. If not EBC certified, the emission values must be analysed Pyrolysis: Covered via EBC C-Sink, if not = emission values Biogas plant: Classified as climate-neutral according to FOEN, but not due to CH4 leakage, would have to be accounted for separately, classified as climate-neutral for the pilot phase.
	Digestion of ruminants	CH4	Yes	CO2 emissions from feeding are considered climate neutral. CH4 emissions from ruminants are included.
	Farmyard manure		Yes	Emissions from liquid manure, compost, fermented manure and fermented thin manure (farmyard manure), fermented manure (farmyard manure), digestate and liquid digestate (recycled manure), solid digestate (recycled manure) are recorded in the system. In the pilot version, fermented farmyard manure products are considered climate neutral; only emissions from storage are considered.

	Power production		Yes	Electricity production from sustainable technologies (solar, wind, pyrolysis, etc.) is assessed as climate neutral. Others are included.
	Heat production		Yes	Heat production from sustainable technologies is assessed as climate neutral. Others are included.
	Electricity and heat consumption	CO_2 eq	Yes	Electricity and heat consumption includes the greenhouse gas emissions resulting from the consumption of purchased electricity and heat and depends strongly on the respective mix. If this is not shown on the invoice, an average value for the respective country is assumed. Private electricity and heat consumption is not included in the climate assessment.
	Business trips with non-business vehicles		Yes	Including indication of means of travel: car, bus, train, plane
	Transport of goods by transport companies		Yes	To own sales location
	Waste disposal		Yes	Plastics used in the field such as cover tiles, mulch tarpaulins, irrigation hoses, greenhouse film, etc. Further waste generation
	Purchased inputs (seed, litter, mulch, fodder)	CO_2 eq	Yes	The transport and production of the resources is included
	Mineral fertiliser	CO_2 eq	Yes	The transport and production of mineral fertilisers is included.
	Plant protection products			The transport and production of the plant protection products is included.

Carbon sinks

Source		Gas	Included?	Explanation
Baseline	Long-term C-Sink	CO_2 eq	Yes	The use of EBC certified vegetal carbon can be considered as a long-term C-sink. Long-term C-sinks are presented in the C-sink portfolio.
	Short-term C-Sink	CH_4	yes	Woody biomass (forest, individual trees, hedges, etc.) and humus build-up can be considered as short-term C-sinks. Short-term C-Sink can be used as compensation for methane emissions. Short-term C-Sink are also very important from the perspective of global warming and are presented in the C-Sink portfolio.

Appendix 2

Conversion: Short- and long-term C-Sink and emissions

Compensation through	Compensation of	GHG potential	Period under consideration
Long-term C-Sink	CO_2	1 tCO_2 eq/t	100 years
	CH_4	28 tCO_2 eq/t	100 years
	N_2 O	298 tCO_2 eq/t	100 years
Short-term C-Sink	CH_4	86 tCO_2 eq/t	20-50 years
	CO2	1 tCO_2 eq/t	20-50 years

Appendix 3

Scenarios and compensation options

Source		Gas	Explanation
Scenario/measure	Emission-reducing processes in animal husbandry	CH_4	Emission-reducing feed additives, longevity, gas filter, use of lactobacilli, dual-use cattle
	Emission-reducing processes in fertiliser storage	CO_2 eq	Ventilation, cover, stirring, lactic acid fermentation, vegetable charcoal

	Use of renewable plastic	CO_2 eq	Replacement of fossil plastic in field use
	Use of renewable energy	CO_2 eq	Replacement of fossil energy sources
	Insertion of short-term C-Sink	CO_2 eq	Humus, trees, hedges, shrubs
	Insertion of long-term C-Sink	CO_2 eq	Biochar
	Purchase of emission certificates	CO_2 eq	

Appendix 4

Country annex: non-quantified processes Central Europe

On farms in Central Europe, the list of non-quantified processes is composed as follows, by way of example:

- Office consumables
- Consumables Workshop/Server/Website/Electronics
- Maintenance of company buildings and premises
- Maintenance of machines, lubricants, etc.
- Veterinarian
- Waste disposal excluding plastics
- Packaging materials
- Transport of seed, litter and mulch

This list should be adapted to the respective local conditions by the VVB.

The emissions caused by this are covered by the margin of safety (see chapter "5.5 Margin of safety")

Appendix 5

Group certification requirements for farm groups in developing countries

A farm group must fulfil the following conditions:

- The group shall consist of members that have similar production systems and, based on these, comparable direct and indirect emissions.
- A group must consist of at least 10 members for a farm to be verified and validated as a group and should not exceed 1000 members.
- The geographical catchment area should not exceed a radius of 200km.

Requirements for the farm group are as follows:

- The group must establish an internal control system, document the processes accordingly and collect data from all group members annually.
- The figures are validated with all members via an internal control.
- The internal validators must be appropriately trained and have knowledge of WCFT and WCFS. The training is provided by the VVB.
- The internal controllers must document what and how they validated the group members and what was the data basis for the values, which must be signed by the validated group members.
- If deviations are found during validation, these must also be documented and measures for improvement must be defined.
- The group leader must have an updated list of all group members with their data entered in the WCFT.
- The members of the group must sign a contract/confirmation that they are part of this group and agree to comply with the specifications and the defined reduction plan and to pass on the data to the VVB and allow external controls.

The group must establish internal rules which include the following:

- How and what data is collected from each member
- What evidence is collected and kept for each data collection (data on activities, purchases, consumption, energy bills, transport costs, etc.).
- How these are to be reviewed.
- Which changes in individual operations must be reported to the group management.
- What steps will be taken if members do not support the reduction plan.

- How and when new members are added to the group and their data is collected and what impact this has on the reduction plan.
- Which criteria lead to exclusion from the group.
- What remuneration the group members receive.

The external VVB must:

- Provide specific training to the persons in charge of control and validation for group certifications - can be delegated to the project partner
- Assess the quality of the internal control system during an annual on-site inspection - can be delegated to the project partner
- Assess the risks regarding the security of the data collected and the homogeneity of the group - can be delegated to the project partner
- Check the plausibility and validate the data at the level of the entire group:
  - Completeness of the data.
  - Controls of all group members by the ICS.
  - New group members and their effect on the overall system.
  - Occurrence of discrepancies in data collection and how these were handled by the internal auditors.
  - Risk-based (criteria: Size of operation, level of emissions, security of data, violations in previous years or in ICS inspections). For at least the square root of all group members, the data inputs and initiated reduction measures must be verified. The selected group members must be representative of the group as a whole.

Responsibilities and sanctions:

- The group as a whole is responsible for data quality and compliance with the reduction plan.
- If sanctions have to be imposed that affect the quality of the ICS, the group as a whole must be sanctioned.