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Project Design Document

Name of project:	Soil and Flame Malaysian Biochar Projects (f.k.a Greater Klang Valley Project)
Name of C-Sink Manager:	Reclimate Sdn Bhd
Project ID:	GCSP1039
Date of issue:	21.11.2025
Methodology:	Global Artisan C-Sink 2.1A
Project location:	1. Sungai Tengi, Selangor
Project start date:	28.02.2024
Project period:	The project has no end date, but it is verified on an annual basis
Project summary:	The project empowers smallholder farmers to transition from open burning and unsustainable waste disposal toward sustainable biochar production. By diverting agricultural residues from polluting practices, the project significantly reduces greenhouse gas emissions and stores carbon permanently in soil while creating a high-quality, organic soil amendment. This not only improves soil fertility and crop resilience but also enhances farmers' livelihoods through access to sustainable agricultural inputs and new opportunities in the carbon economy. The project will increase carbon sequestration by working the produced biochar into different matrixes and in this way create a long-term carbon storage with a persistence of up to 1000 years as according to the Global Artisan C-Sink Standard. Without the project, no C-sink would be created since Paddy straw and woody sticks does not constitute a long-term carbon reservoir. In the initial 5 years of the project we expect carbon sequestration of approximately 56,863 CO2eq in total or 11,372.6 CO2eq / year.

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1. Purpose and general description of the project

The Soil and Flame Malaysian Biochar Projects compromises 3 Artisan Biochar Producers for biochar production from paddy straw and woody sticks. Biochar is a versatile material with an increasing number of applications in agriculture, environmental engineering, and basic industry. Biochar applied a matrix permitted by the Global Artisan C-Sink Standard poses a stable carbon sink (C-sink). Without the project, no C-sink would be created since paddy straw and woody sticks does not constitute a long-term carbon reservoir.

In the absence of the project, smallholder farmers typically dispose of agricultural residues through open burning or uncontrolled decomposition. These practices release significant greenhouse gases such as CO_2, CH_4, and N_2O, while also contributing to air pollution and soil degradation. Farmers lack access to sustainable waste management alternatives, financial incentives, know-how and techniques resulting in ongoing environmental harm and missed opportunities to improve soil health and productivity.

Another objective of the project is to improve the soil quality in Malaysia by marketing biochar as soil amendment. Biochar can improve soil quality significantly because of its impact on the soil pH, its water retention capacity, and its ability to store nutrients.

The monitoring and tracking of this project will be carried out by Reclimate Sdn Bhd. In the project the digital MRV technology named Circonomy. This will monitor, report and verify biochar production and carbon sequestration.

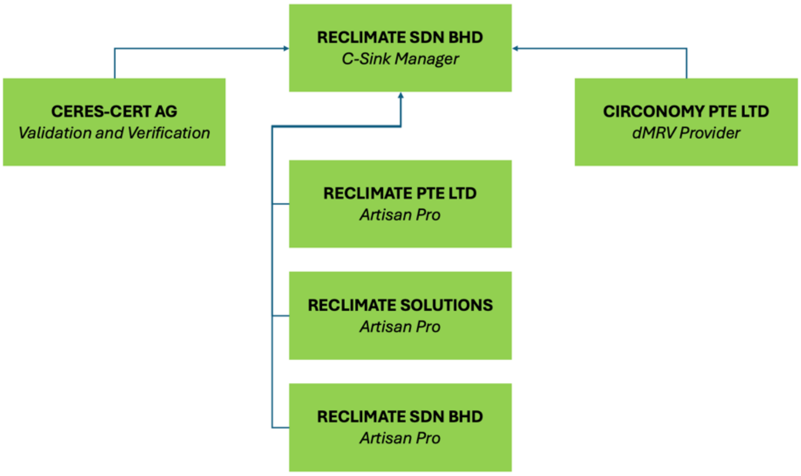
1.1. Project location

1. B33, Kampung Fajar Selangor Sungai Tengi Selatan 44020 Kuala Kubu Baru, Selangor

The geographical locations of the subsequently installed Biochar Artisan Producers will be documented in the *dMRV tool*. The GPS location of Artisan Biochar Producers is listed on Annex 7.1.

Sungai Tengi Selatan, Selangor

1.2. Stakeholders and partners involved



1.3. Description of baseline scenario

Before the project, agricultural residues generated by smallholder farmers were largely unmanaged, with the predominant practices being open burning in fields or leaving the biomass to decompose naturally. These methods released substantial greenhouse gas emissions, including CO_2, CH_4, and N_2O, and contributed to local air pollution and declining soil quality. Farmers had limited incentives or resources to adopt alternative waste management approaches, and there were no structured systems in place for converting residues into valuable products. With the project, the activity shifts from wasteful and polluting practices toward sustainable biochar production, creating both environmental benefits and new socio-economic opportunities for participating farmers.

The baseline scenario for carbon removal accounting is the "business as usual", in which no permanent biochar-based carbon sink is generated and is considered as zero. The fact that biomass could have been used differently in the baseline scenario, has no impact on the consideration of the baseline as zero.

$C - sink\ (Baseline)\ =\ 0\ tCO2e$

1.4. Biochar carbon sinks

When plant biomass is burnt or decomposed, the assimilated carbon is released again in the form of CO_2. However, if the plant biomass is pyrolyzed, about half of the plant carbon is transformed into a mixture of predominantly very persistent carbon compounds that form a solid material known as biochar. While in the environment, any carbon compound is subject to degradation; for most components of biochar, this process is extremely slow, and mostly even so slow, that it is hard to measure for thousands of years. Provided that the biochar is not burned, the biochar carbon remains as a C-sink in the terrestrial system.

If biochar with an H to Corg ratio < 0.40 is applied to soil, a major part of its carbon is considered Persistent Aromatic Carbon (PAC, the portion of biochar carbon bound in clusters of more than seven aromatic rings as analyzed by the hydro pyrolysis method) and will constitute a carbon sink for several millennia. A minor though relevant part of the biochar-carbon is less persistent (semi persistent carbon, SPC) and likely to be microbially degraded within decades to centuries, presenting a mean residence time of 50 years. The biochar carbon that may be decomposed within the first 1000 years after the application to soil is called Semi-Persistent Carbon (SPC) and constitutes a temporary C-sink. For biochars presenting an H to Corg ratio < 0.4, the PAC fraction is conservatively fixed by the standard at 75% and the SPC fraction at 25%.

1.5. Project Boundary

All emissions occurring due to biomass sourcing, biochar production and application are accounted for and will be adequately offset by registered carbon sinks.

In this project, the boundary includes the following aspects:

- Biomass sourcing: Cultivation, harvesting, transportation, crushing
- Pyrolysis: pyro-gas combustion (e.g. methane emissions), electricity if needed by the technology as well as fossil fuel consumption for pre-heating the reactor
- Biochar processing: emissions due to milling, blending, transportation and soil/material incorporation
- A margin of security

Biomass Sourcing → **Pyrolysis** → **Biochar Processing**

MARGIN OF SECURITY

1.6. Eligibility

☒ Production of biochar according to Global Artisan C-Sink conditions.
☒ Farmers and Artisan Biochar Producer are not certified under any other methodology for nature-based climate service (i.e. biomass production and soil organic carbon).
☒ Social Impact: Involved parties have to be compensated fairly and transparent.
☒ Project location: Project is located in low- or middle-income country according to the World Bank classification.
☒ Biochar production does not exceed 100m3/year for a single C-Sink Farmer or 1500m3/year for a single Artisan Pro and is done with a low-tech production unit.
☒ The C-sinks issued in this project are not claimed in any other Carbon Crediting Scheme.

1.7. Additionality

Artisanal Biochar Producers do not generate income yet with biochar in most regions, there is no market for biochar-based fertilizers, and the production costs are higher than the expected agronomic benefit, or tropical smallholder farmers do not have the financial resources to pay biochar-based fertilizers. Farmers could produce their biochar from their feedstock to improve their yields, but without the training provided by the Global Artisan C-Sink Manager, they would hardly acquire the craft to do so. The Community Service Activity is a central aspect of the project.

The Global Artisan C-sink will, thus, be the decisive monetary incentive and knowledge transfer to produce climate positive biochar and thus carbon sinks. The Global Artisan C-Sink Manager will provide not only training on biochar production but also on the preparation and application of biochar-based fertilizers, which (a) will enable most farmers to establish this practice and (b) will avoid the adoption of unsustainable biochar production practices which could result in pollution and GHG-emissions. Moreover, methane compensation, as introduced by the Global Artisan C-sink is a key element to achieving net negative emissions with Kon-Tiki based biochar C-sinks.

Global Artisan C-sink assures the adoption of low-emission technology, methane compensation, and the use of sustainably sourced biomass. Without those boundary conditions, biochar production in countries with low purchasing power and limited financial and technical possibilities would hardly result in net negative emissions. Hence, additionality of any C-sink certificates issued under this standard is guaranteed.

2. Ex-ante estimate of impact

The estimations are based on the dry matter amounts of biomass and the resulting biochar. The C-sink is calculated as the expected amounts of biochar multiplied by the expected carbon content.

The established temporary C-sinks are based on the SPC fraction (25%) of the biochar or the lifetime of the products where the biochar is applied to temporary matrixes (e.g. cement/concrete in buildings).

The established permanent C-sinks are based on the PAC fraction of the biochar (75%), when the biochar is applied to soils and has a H/C ratio below 0.4.

The ex-ante estimate is based on the following values:
Paddy Straw

Yield factor (feedstock to biochar): 0.25 t biochar (DM)/t feedstock (DM)

C-content of biochar: 37.8% (based on preliminary analysis)

Year of operation	Amount of feedstock (t DM)	Amount of biochar produced (t DM)	Established temporary C-sinks (tCO_2e)	Established permanent C-sinks (tCO_2e)
1	4000	1000	342	1025
2	12000	3000	1025	3074
3	20000	5000	1708	5123
4	30000	7500	2561	7684
5	40000	10000	3415	10245
sum	106000	26500	9050	27149

Woody sticks

Yield factor (feedstock to biochar): 0.51 t biochar (DM)/t feedstock (DM)

C-content of biochar: 74.67% (based on preliminary analysis)

Year of operation	Amount of feedstock (t DM)	Amount of biochar produced (t DM)	Established temporary C-sinks (tCO_2e)	Established permanent C-sinks (tCO_2e)
1	1000	511	251	1143
2	2500	1277	628	2857
3	5000	2554	1257	5714
4	7500	3830	1885	8571
5	10000	5107	2514	11428
sum	26000	13278	6536	29714

3. Technology and business cases

3.1. Artisan Biochar Producer

An Artisan Pro is a registered company or part of a registered company. An Artisan Pro may have several production units and artisans that run these. Artisan Pro biochar is professionally produced by a company, an association, or an individual using all sorts of eligible biomass found within a radius of *30 km* from the production site. Artisan Pro biochar is not necessarily applied back to the fields where the biomass was grown but is mostly traded to other farms and industries. Artisan Pro biochar is produced at a registered production site with registered production equipment. It can be produced by several trained Artisan Biochar Producers (i.e., employees of the certified company), though they work at the same site with the same equipment. The maximum annual biochar production is 1500 m^3 per year.

The (sample) contract between the Global Artisan C-Sink Manager and Artisan Biochar Producers Artisan Pro was presented to the Certifier (Annex 7.2).

3.1.1. Training of Artisan Biochar Producer

In this project, Global Artisan C-Sink Manager ensures that the Artisan Biochar Producers are qualified to produce high-quality biochar with low emissions through an internal training protocol. The Artisan Biochar Producer follows a biochar production training given by a qualified trainer and prove their proficiency in an exam. The training includes principles of feedstock selection and biomass drying, the biochar kiln operation principles, the volume measurement of the produced biochar, a biochar sampling procedure, and the proficient use of the Artisan smartphone app.

The details of content, duration and learning goals (internal training protocol) were presented to Carbon Standards and the Certifier (Annex 7.3).

3.2. Feedstock

The Global Artisan C-Sink Managers ensures that the biochar is made from biomass feedstock that originated from the artisan’s farm or from biomass processing such as cocoa mills, coffee pealing, rice thrashing, sawmills, and comparable industries. Biomass may also come from disaster debris, maintenance of fallow fields, or dedicated biomass production like bamboo or switch grass plantations.

In the project the following feedstocks are used which is eligible with the sustainability criteria:

Paddy straws and woody sticks which are agricultural residues that are discarded.

3.2.1. Origin of feedstocks:

The project sources two main types of feedstock:

- **Woody wastes** – generated from a lemon myrtle farm located within the project production site. These residues were previously left to decay or occasionally used as low-grade firewood.

- **Paddy straw** – collected from nearby paddy fields around the production site. Farmers traditionally managed straw by burning it openly after harvest or leaving it in fields to decompose, both of which released substantial GHG emissions and contributed to local air pollution.

Storage of these residues was minimal, as farmers and mills typically sought quick disposal due to space limitations and lack of commercial value. This resulted in feedstocks being underutilized and treated as waste rather than a resource.

3.2.2. Leakage

The project is not expected to cause significant leakage. The targeted feedstocks: paddy straw, coconut shells, and woody wastes from lemon myrtle farming currently have limited productive uses. Paddy straw and coconut shells are predominantly managed through open burning, releasing GHG emissions and contributing to local air pollution, while woody wastes are left to decompose. Since these residues are primarily treated as waste rather than essential resources, diverting them into biochar production does not displace any critical use. Consequently, the project will not create a resource gap that communities would need to compensate for with alternative fuels or materials.

3.2.3. Methane emission during storage of biomass

To avoid methane emissions during storage of biomass the following measures are taken:

- The feedstock must not be used freshly cut or from a feedstock pile where it rained upon.
- Feedstock needs to be stored airy and protected from rain.
- To avoid methane emissions from feedstock storage, wet feedstock must not be piled higher than a meter. Otherwise, the humid feedstock will self-heat, consume the oxygen inside the pile and decompose anaerobically, which produces significant amounts of methane.
- When feedstock got exposed again to rain, a new period of at least three days of thinly layered sun drying has to start.
- Touching the feedstock must not feel humid.
- The water content of feedstock should be below 25% when used in the Kon-Tiki or TLUD. Simple, low-cost digital devices exist to measure feedstock humidity, which must be used at the biochar trainings so that Artisan Biochar Producer get the experience of how to test the feedstock for humidity even without digital devices. Producers of more than 100 m^3 biochar per year are required to measure the feedstock humidity with an appropriate device and record it in the production protocols. Here, the average humidity is recorded using five measurements with the handhold device per m^3 of feedstock.
- Both, feedstock drying and correct bulkiness of the feedstock blend, is an essential part of the initial Artisan Biochar Producer training.

3.3. Production unit

Biochar is produced via pyrolysis technology. Pyrolysis means the thermo-chemical decomposition of the feedstock under the exclusion of oxygen.

The produced biochar is certified under the Global Artisan C-Sink standard, what guarantees that the biomass feedstock is sustainably procured and produced, biochar fulfils the analytical threshold values, so no damage is caused to the environment, emissions limits of the pyrolysis unit are adhered to, and storage procedures are environmentally sound.

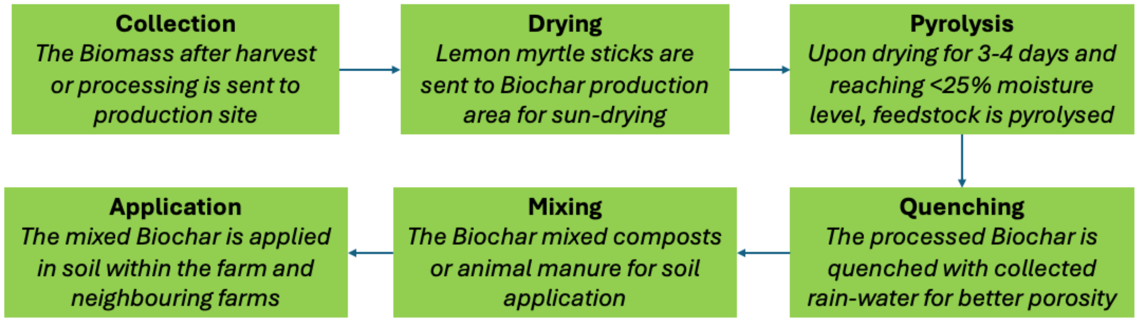
The biochar production follows the Global Artisan C-Sink standard, which ensures:

- Only trained Artisan Biochar Producer are allowed to produce biochar
- Minimization of risks on human health, social and environmental impacts
- No forest wood and slash of forest trees are permitted as feedstock

Flame Curtain Pyrolysis (the Kon-Tiki method)

The principle of flame curtain pyrolysis consists of pyrolyzing biomass layer by layer in a conically-, polygonal-, rectangular-, or cylindrical-formed metal, concrete, or soil kiln.
A fire is started in the kiln, and the embers spread to form a first layer on the bottom of the kiln. A thin layer of biomass is then added on top of the embers, heats quickly and starts outgassing. The rising pyrolysis gas is caught in the flame curtain and reacts with combustion air entering the kiln from the top. When ash appears on the outside of the carbonizing biomass, the next layer of biomass is homogenously spread on top. Convective and radiant energy from the flames above and from the hot pyrolyzing layers below heat up the fresh biomass layer, which starts to pyrolyze.
The biochar below the upper pyrolysis layer is shielded from oxygen access by the fire curtain itself. The combustion zone thus forms a flame curtain that protects the underlying biochar from oxidizing and cleanly burns all pyrolysis smoke and gases as they pass through this hot fire front. The manual layering of biomass is repeated until the metal kiln or soil pit is filled.
The pyrolysis process is then actively ended by quenching with water or a nutrient solution (e.g., diluted urine, dissolved fertilizer) which is fed into the kiln from below if possible or, where water is not easily available, by snuffing with a layer of soil.

3.3.1. Example of biochar production flowchart



3.4. Suitability of Artisan Biochar for Agriculture

Based on the Global Artisan C-Sink standard, Kon-Tiki and TLUD biochar was extensively analyzed following the EBC and WBC analytical requirements. All biochar that was produced from eligible feedstock with the Artisan endorsed technologies fulfilled all requirements of EBC and WBC certification. PAHs and other potential contaminants were found with generally low contents that allowed in all cases the certification as WBC-Agro. As PAH contents of biochar are mainly technology dependent and generally low in Kon-Tiki and TLUD biochars, the Global Artisan C-Sink standard does not require its regular analysis. Meeting the PAH thresholds is covered by the pyrolysis-type accreditation of the Kon-Tiki. Therefore, biochar produced under the Artisan Standard are suitable for agricultural uses as they fulfill all requirements of WBC-Agro.

The sample plan was presented to Carbon Standards International (Annex 7.4).

3.5. Application and trade of biochar

The following applications are possible for this project:

- Geological C-sink (biochar applied to soil)

3.6. Methane emissions compensation

Compensation of methane emissions by avoiding GHG-emissions from burning crop residues

The primary feedstocks, coconut shells and paddy straw, are predominantly disposed of through open-air burning at mills and fields, releasing large amounts of CO_2, CH_4, and other pollutants. By diverting these residues into biochar production, the project avoids high-emission disposal pathways and instead locks carbon in a stable form while generating soil and livelihood benefits.

A declaration of honor was submitted to Carbon Standards and approved (Annex 7.7).

Compensation of methane emissions by avoiding GHG-emissions from biomass decomposition Woody wastes from the lemon myrtle farm are typically left on-site to decompose in an uncontrolled manner, producing CH_4 and N_2O emissions over time. By channelling this biomass into biochar production, the project prevents these emissions and secures long-term carbon storage in a stable form. A detailed description and flow chart with the current practices was submitted to Carbon Standards and approved (Annex 7.8).

3.7. digital Monitoring, Reporting and Verification (dMRV)

Technically, the C-Sink Artisan certification procedure is based on a digital monitoring, reporting, and verification (dMRV) tool, which is usually a dedicated smartphone application.

In this project the dMRV system of Circonomy, which is endorsed by Carbon Standards will be used to fulfil the requirements of the Global Artisan C-Sink Standard.

3.8. Planned business development

The Artisan C-Sink Manager plans to steadily expand operations by sourcing additional biomass feedstocks beyond the current paddy straw, coconut shells, and woody wastes, ensuring a reliable and scalable supply for biochar production. The produced biochar will be distributed through multiple channels: free of charge to low-income farmers to strengthen their soil health and food security, and at subsidized prices to other farmers and agricultural stakeholders, with carbon finance revenue used to offset production costs.

As markets for biochar continue to develop, the project will play a catalytic role in creating and boosting demand by demonstrating its agronomic and environmental benefits, while also working with cooperatives and distributors to reach more farmers efficiently. The business model emphasizes scale-up through decentralized production hubs, enabling localized feedstock use, reduced logistics costs, and stronger community participation. Over time, Artisan C-Sink Manager will also engage in partnerships with research institutions, agri-businesses, and government programs to promote biochar adoption, standardization, and integration into sustainable farming practices.

3.9. Internal Control System

A blueprint of an Internal Control System (ICS) was presented to the Certifier (Annex 7.9).

The template for the Internal Inspection Report was presented to the Certifier (Annex 7.10).

4. Determination of C-sink

4.1. Monitoring

All data which is required to calculate the C-sink is entered into a dMRV System. The dMRV system used in this project is provided by Circonomy.
The data will be monitored as mentioned below.

4.1.1. General data

The following general data will be monitored:

Parameter	**Monitoring frequency**	**Source of data**
Artisan Biochar Producer Registration	per year	Internal documentation
Proof of successful participation in an artisan biochar workshop	per year	Internal documentation
Producers list	per year	Internal documentation
H/Corg ratio	per feedstock type	Laboratory report (laboratories endorsed by Carbon Standards, see https://www.carbon-standards.com/en/standards/service-505~global-artisan-c-sink.html section Laboratories)
C-content of biochar	per feedstock type	Laboratory report (laboratories endorsed by Carbon Standards, see https://www.carbon-standards.com/en/standards/service-505~global-artisan-c-sink.html section Laboratories)
Bulk density of biochar	per feedstock type	Internal documentation, dMRV
Feedstock preparation	per feedstock type	production protocols, dMRV
Documentation of technology used	per Artisan Biochar Producer	Internal documentation, dMRV
Volume measuring device	per Artisan Biochar Producer	Internal documentation, dMRV
Definition of a production load	per production unit type	Internal documentation, dMRV

The following general conversion rates are fixed ex-ante:

Parameter	**Ex-ante definition; value**	**Source of data**
CO_2 emissions from diesel	2.7 kg CO_2eq / l diesel	Methodology, Juhrich, 2016
CO_2 emissions from heavy fuel	65 t CO_2eq / TJ	Methodology, Juhrich, 2016

4.1.2. Artisan Biochar Production

Artisan Pro

For each Artisan Pro the following parameters will be monitored:

Parameter	Monitoring frequency	Source of data
Annual on-site inspection	per year	Internal documentation, dMRV
Feedstock type	per load	dMRV
Moisture content of feedstock	per load	dMRV
Total amount of feedstock (dry matter) used for the load	per load	dMRV
Average feedstock size	per load	dMRV
Location of production unit	per load	dMRV
Registration of each biochar production load	per load	dMRV
Amount of biochar produced	per load	dMRV
Proof of retention sample	per load	dMRV
Documentation of biochar mixing to matrix	per load	dMRV
Amount of volume applied to each matrix	per load	dMRV
Receiver address/location when biochar (mix) is sold	per trade	dMRV

4.1.3. Compensation of Fossil Emissions

All fossil CO_2 emissions are offset by long-term carbon sinks before the registration of a biochar C-sink is validated in the Global C-Sink Registry.
CO_2 is only offset with geological C-sinks, such as the persistent aromatic carbon (PAC) fraction of soil-applied biochar, that are registered in the Global C-Sink Registry.
The emission offsets are realized with the registered permanent biochar C-sink whose production had caused the emission.

Parameter	Monitoring frequency	Source of data
Proof of compensation	annually	Global C-Sink Registry

4.1.4. Production unit

☒	The production unit used in the project has a system certification, see system endorsement.

	Pyrolysis system Kontiki/Soil pit is accredited by Carbon Standards. The mean methane emission for Kontiki/Soil pit is known to be 30 kg CH_4/t DM biochar produced.

Accordingly, ex-ante definition of the following parameter:

Parameter	Ex-ante definition; value	Source of data
[CH_4_emissions_pyrolysis]	30 kg CH_4/t DM biochar	Global Artisan C-Sink Version 2.1A

4.1.5. Compensation of methane emissions

Methane compensation is defined as creating a carbon sink for 20 years that has a climate cooling effect equal to the climate warming effect of a methane emission over 100 years after the emission occurred. Thus, the total climate forcing of a methane emission is compensated within 20 years after the initial emission.

Parameter	Monitoring frequency	Source of data
Proof of compensation	per C-Sink Unit	Global C-Sink Registry

4.1.6. Margin of Security

For this project, the emissions based on the system boundaries are accounted for. To also address GHG emissions caused by activities not tracked in detail, a *Margin of Security* is applied.

This includes, for example, the emissions caused by:

- the fuel for transportation of the biomass feedstock to the kiln,
- or the transportation of the biochar to the field (up to 100 km),
- the displacement of the kiln
- a pump for quenching water
- fuel for a chain saw for pruning, milling, and blending of the biochar

$$[Margin\ of\ Security] = [produced\ biochar\ (t)] * 0.02\ (t\ CO2e\ per\ ton\ of\ biochar)$$

4.1.7. Methane emissions

During biomass storage and pyrolysis process methane emissions are produced. They are calculated according to the following formula:

$$[Total\ methane\ emissions] = [Feedstock\ storage\ emissions\ per\ batch] + [CH4\ emissions\ from\ pyrolysis\ of\ entire\ batch]$$

4.1.7.1. Methane emissions from the storage of biomass

If methane emissions are negligible according to Section 3.2.3 **Error! Reference source not found.**: 0 tCH_4

4.1.7.2. Methane emissions from production unit

Emissions are calculated in **kg CH_4.**

$$[CH4\ emissions\ from\ production\ unit\ per\ load] = [CH4\ _{emissions_{pyrolysis}}] * [amount\ of\ biochar\ dry\ matter]$$

4.1.7.3. Compensation of the methane emissions

The AGWP_CH4(100) must then be compensated by a same-sized absolute global cooling potential (AGCP) over a maximum of 20 years. The compensating global cooling starts in the same year as the CH_4 emission occurred, provide annual global cooling in every following year, and finalize the compensation latest 20 years after the methane emission.

In order to claim that methane emissions where compensated it must be proven that

$[AGCP(20)] \geq [AGWP\_CH4(100)]$.

4.1.7.4. Absolut Global Warming Potential of methane emissions

The Absolute Global Warming Potential of the methane emissions are calculated based on:

$$AGWP\_CH4(100) = \sum_{t=0}^{99} (IRF\left(CO_{2,a}(t)\right) * [CO_2e\ of\ CH_4\ emissions\ per\ load]\ )$$

To calculate the *Absolute Global Warming Potential (AGWP)* over 100 years we are using Jeltsch-Thömmes & Joos (2019)[1] to calculate the decay of the CO_2. Greenhouse gases decay in the atmosphere. The quantities of CO_2 still present in the atmosphere each year are added up over the 100 years, resulting in the absolute global warming potential (AGWP) over 100 years.

The decay is described by the equation:

$$[IRF(CO_{2,a}(t))] = a_0 + \sum_{i=1}^{5} a_i * \exp\left(\frac{-t}{\tau_i}\right) for\ t \geq 0$$

With the values

i	ai	ti
0	0.008	
1	0.044	68521
2	0.112	5312
3	0.224	362
4	0.31	47
5	0.297	6

The resulting methane emissions of the produced biochar are calculated as below, with the GWP100 (CH_4) value of 25 CO_2e.

$$[CO_2e\ of\ CH_4\ emissions\ per\ load] = [Total\ methane\ emissions] * [GWP100_{CH4}]$$

[1] Jeltsch-Thömmes, A., Joos, F., 2019. The response to pulse-like perturbations in atmospheric carbon and carbon isotopes 1–36.

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4.1.7.5. Absolut Global Cooling Potential of SPC fraction

The Absolut Global Cooling Potential (AGCP) of the SPC for the first 20 years is calculated as follow:

$$[AGCP(20)] = \sum_{t=0}^{20} (C_{remain}(t, SPC) * \ IRF(CO_{2,a}(t) * M_{biochar} * C_{content})$$

With:

C_{remain} (t, SPC) as the adjusted equation 2 of Global Artisan C-Sink Standard for the SPC fraction of the biochar (25%)

$$[C_{remain}(t, SPC)] = \frac{1}{1000} * (750 + 45 * \ e^{-0.5232*t} + 205 * \ e^{-\ 0.009966*t}) - 0.75$$

Calculation of leakage emissions

The leakage emissions are calculated based on the results of the assessment in chapter 3.2.2.

$$[Leakage\ emissions] = 0\ tCO2e * \ [amount\ of\ biomass\ dry\ matter\ (batch)]$$

5. Registration of C-sink

Biochar carbon sinks is registered with the geo-localized area where the biochar or its derived products have been applied.
In certain specific instances where marginal quantities of biochar are applied or utilized in products, the registration of so-called diffuse carbon sinks (i.e., non-geo-localized) is permitted.

The following information are registered for biochar carbon sink:

1 Feedstock of biochar production
2 Technology of production
3 Date or period of production
4 C-content and H/C ratio of biochar (measured or taken from the Ithaka database)
5 Matrix into which the biochar was mixed (compost, manure, feed, cement etc.)
6 Location of the C-sink (vector file of field location; for fields < than 1000 m2 one GPS point per field is sufficient, for C-Sink Networks and C-Sink Villages only the vector file of the network and village, respectively, is needed)
7 Amount of biochar applied in tons (dry matter tons)
8 Date of application
9 Owner of the C-sink site (name, address, birth date – not necessary for C-Sink Network and C-Sink Village)
10 C-sink project design document
11 Validation report of the validation body
12 Verification report of the verification body
13 Monitoring plan of the operation
14 Confirmation of the compensation of the emission portfolio of the biochar

5.1. Calculation of C -sink

The C-sink is registered in the Global C-sink Registry.

Based on the Global Artisan C-Sink standard, the calculation of the carbon for C-sink at day of application is:

$$[Carbon\ for\ C-sink\ (kg\ C)] = [dry\ mass\ of\ biochar\ applied\ (kg)] * [Carbon\ content\ (\%)]$$

However, every biochar C-sink underlies a time-dependent evolution, and the C-sink is a measure of the mass of carbon that is physically present in the C-sink matrix at any given moment in time since the establishment of the C-sink. The size of a biochar C-sink is, thus, a function of the type of biochar determining its specific persistence in a specific C-sink matrix and the time since the application to the C-sink matrix.

$$C-sink(year) = C-sink(year=0) * specific\ persistence\ (year)$$

5.1.1. Geological C-sink

According to the Global Artisan C-Sink standard, Biochar made in a Kon-Tiki reach highest treatment temperatures above 650°C and present an H/Corg ratio well below 0.4, indicating a PAC fraction of at least 75% when applied to soil. Certified artisan biochar is, therefore, registered with a PAC-fraction of 75% and SPC fraction of 25% in the Global C-Sink Registry.

The remaining carbon for soil-applied biochar is calculated with the following conservative approximation:

$$C_{remain}(years) = \frac{M_{BC} * C_{Content}}{1000} * (750 + 45 * \ e^{-0.5232*years\ of\ decay} + 205 * \ years\ of\ decay)$$

For the compensation of the GHG emissions within the system boundaries, only the PAC fraction is used.

6. Public consultation

During public consultation the following comments were raised:

Comment	Was comment taken into account (Yes/ No)?	Explanation/ justification (Why? How?)
xx	xx	xx
xx	xx	xx

7. Annexes

Please submit the annexes in a separate folder and adjust the numbering accordingly.

7.1. Producer lists and GPS coordinates *)
7.2. Sample contract between Artisan C-Sink Manager and Artisan Biochar Producer (Make sure to add the clause of the ownership/ transfer of the C-Sink)
7.3. Internal training protocol
7.4. Sampling Plan (Refer to section 15 of the standard)

7.5. Acceptance letter from Carbon Standards International and Example of Declaration of honour for cease open field burning *)
7.6. Acceptance letter from Carbon Standards International and flow chart of current practices for methane compensation through avoiding GHG-emissions from biomass decomposition *)
7.7. Blueprint of the Internal Control System (ICS) *)
7.8. Template Internal Inspection Report
7.9. Social responsibility declaration *)

**) Template/ guidance are provided in the endorsement call.*