METHODOLOGY ASSESSMENT REPORT ASSESSMENT REPORT ON METHODOLOGY FOR BIOCHAR UTILIZATION IN SOIL AND NON-SOIL APPLICATIONS

Document Prepared by TÜV NORD CERT GmbH

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Methodology Title	Methodology for biochar utilization in soil and non-soil applications
Version	1.1
Methodology Category	Methodology
Sectoral Scope(s)	13 – Waste Handling and Disposal
Report Title	Assessment report on Methodology for biochar utilization in soil and non-soil applications
Report Version	1.0
Client	VERRA
Pages	170
Date of Issue	04/08/2022

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Summary

VERRA has commissioned the TÜV NORD JI/CDM Certification Program to carry out the assessment of the "Methodology for biochar utilization in soil and non-soil applications" in accordance with the VCS Methodology Approval Process, the VCS Program Guide v4.1, and the VCS Standard v4.2.

The Methodology provides "procedures and factors required to determine the greenhouse gas (GHG) benefits of biochar production and utilization". The methodology quantifies net emissions of CO2 and CH4 from GHG impacts into the three important stages of a biochar value chain: sourcing stage, production stage, and application stage (i.e., the use of biochar into soil or non-soil applications).

The purpose and scope of the new methodology element assessment was to evaluate whether the methodology document was prepared in line with the VCS program requirements. TUV NORD's assessment includes a detailed review of adherence to the VCS Methodology Approval Process, the VCS Program Guide, and the VCS Standard, with regard to correct filling of the VCS methodology template, applicability conditions, project boundary, baseline approach, additionality, GHG accounting of baseline and project emissions, leakage, monitoring, data and parameters, and adherence to the principles of the VCS rules and requirements (relevance, completeness, consistency, accuracy, transparency and conservativeness). TUV's assessment further includes a detailed analysis of the methodology, background research including literature reviews and how due account has been taken on comments received during global stakeholder consultation as well as technical review and responses to all findings raised based on the VCS rules and requirements.

The assessment team identified 29 findings in total of which are 17 CLs and 12 CARs and no FAR. All were addressed satisfactorily in line with the VCS program requirements. These NCRs, CLs, and OFIs provided necessary clarity to ensure the methodology was in compliance with the VCS rules and requirements.

TÜV NORD CERT confirms all methodology assessment activities, including objectives, scope and criteria, level of assurance and the methodology's adherence to the VCS Program and VCS Standard, as documented in this report, are complete. TÜV NORD CERT concludes without any qualifications or limiting conditions that the "Methodology for biochar utilization in soil and non-soil applications" (v1.0, 18-07-2022) meets the requirements of VCS Rules and Requirements. TÜV NORD CERT recommends that Verra approves the methodology.

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1 INTRODUCTION

1.1 Objective

VERRA has commissioned TÜV NORD conducting the assessment of the newly developed methodology entitled

"*Methodology for biochar utilization in soil and non-soil applications*"

TÜV NORD has therefore conducted the assessment of this new methodology in accordance with VCS Methodology Requirements ver 4.1.

1.2 Summary Description of the Methodology

The new methodology assessed contains the procedures and factors required to determine the greenhouse gas (GHG) benefits of biochar production and utilization. The methodology falls within the Waste Handling and Disposal (WHD) sectoral scope of the Verified Carbon Standard (VCS) Program.

This globally applicable methodology provides criteria and procedures for the quantification of GHG benefits following the adoption of improved Waste Handling and Disposal (WHD) practices to produce biochar. Project activities include the final utilization of biochar in soils or non-soils applications.

A typical project activity under this methodology would be the production of biochar using pyrolysis or gasification technology from waste biomass e.g. from cocoa plantation and use the biochar either for soil application in e.g. agricultural sector or non-soil application in the e.g. cement or asphalt sector.

2 ASSESSMENT APPROACH

2.1 Method and Criteria

A methodology specific assessment plan was developed to guide the assessment auditing process to ensure efficiency and effectiveness. The purpose of the assessment is to present a risk assessment for determining the nature and extent of assessment procedures necessary to ensure the risk of auditing error is reduced to a reasonable level. According to the ISO14064-3, the criteria are the policy, procedure or requirement used as reference against which evidence is compared to. Therefore, assessment of the new proposed methodology was measured for compliance against the criteria included in the following regulatory documents:

- VCS Methodology Requirements ver. 4.1
- VCS Program Definitions ver. 4.1
- VCS Program Guide ver. 4.1
- VCS Standard ver. 4.2
- VCS Methodology approval process ver. 4.0

The assessment process derived from all items in the criteria stated above. Thus, based on the project parameters, scope and best professional judgement of the verification team it could be concluded that a reasonable level of assurance is met. The verification consists of the following three phases:

- Remote document review
- Remote assessment and interview of project owner;
- The resolution of outstanding issues and the issuance of the final assessment report.

2.2 Document Review

The new proposed VCS Methodology and supporting background documents related to the methodology were reviewed. Document review was conducted to ensure consistency with and to identifying any deviation from VCS program requirements. Desk review included an examination of the methodology details such as use of correct templates, correctness of definitions, set-up of project boundary conditions, method for demonstration of baseline scenario and additionality, methods for quantification of GHG emission reductions as well as potential set of data and parameters to be monitored.

Furthermore, the verification team used additional documentation by third parties like host party legislation, studies, and technical or scientific reports referring to the technology, or to the basic conditions and technical data.

The references used in the course of this verification are summarized in Appendix 3.

The verification was performed based on the documents check and review of measurements method. Refer Appendix 3*: References* of this report for the verification process for each parameter detail and corresponding documents verified.

2.3 Interviews

The objective of the interview process was to solicit important information from personnel related to development of the methodology and corresponding stakeholders as well as persons who provided comments to the draft version of the methodology. Interviews are conducted remotely and information discussions were conducted with methodology developers, stakeholders and persons who provided comments as well as any consultant. The interviews were performed by the assessment team remotely.

The team leader conducted the interviews with the related stakeholders via MS Teams conference communication tool.

The team leader has interviewed the following persons on topics listed in below table:

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Vera	Andrea	Forliance	22/11/ 2021	- Typical project activity under the methodology for each type considered. - Definitions - Applicability conditions - Project boundary - Baseline scenario approach - Additionality criteria and set-up, activity method and positive list - ER Calculation (baseline, project and leakage emissions and risk of reversal) - Monitoring parameters and monitoring plan - Stakeholder comments and resulting changes.	Mr. Stefan Winter
2.	Aggarwal	Chetan	Southpole			
3.	Etter	Hannes	Southpole			
4.	Delaney	Matt	Delaney Forestry Services			
5.	Manley	Simon	Biochar Works			

2.4 Assessment Team

Relevant Experience of the Lead Auditor: Mr. Winter Stefan is Head of JI/CDM Certification Program of TÜV NORD CERT GmbH and within the Program appointed Greenhouse Gas Senior Assessor. In his role as head he is responsible for the implementation of the related Quality Management System of the Validation, Verification and Certification activities in accordance with the JI/CDM/VCS/GS4GG/CCB/PAF/WCD/MAAP/ISO14064-2/Upstream Emission Reduction based on EU Council Directive 2015/652 Guidelines and methodologies which includes inter alia appointment of assessors/auditors and ensuring the allocation of the valid documents.

Within his more than 10 years of experience as an auditor under JI/CDM he specializes in the validation and verification/certification of energy generation and efficiency projects. He is appointed for the technical areas 1.1 (thermal energy generation), 1.2 (renewable energies), 2.2 (heat distribution), 3.1 (energy demand), 4.1 (cement and lime production), 4.2 (paper), 5.2 (Caprolactam, nitric and adipic acid), 9.1 (Aluminium and magnesium production), 9.2 (Iron, steel and Ferro-alloy production), 13.1 (solid waste and wastewater) and 13.2 (manure). His scope of work includes the auditing and assessment of the financial analysis (financial models), the technical feasibility of projects and the assessment of the applicability of methodologies to project activities and PoAs as well as the achieved carbon reductions as well as the related energy saving or generation. Furthermore, besides onsite audits he conducts the technical review of JI/CDM/VCS/GS4GG/CCB/PAF/WCD/MAAP/ISO14064-2/UER projects as well as the final approval of validation or verification opinions. He has extensive experience of working in China, India and South-East Asia.

Besides, Mr. Winter is an appointed Senior Auditor under the EU-ETS since 2013 and verifies the carbon emissions of mainly combined heat and power plants, coke and steel industry as well as fertilizer production.

Qualifications: Mr. Winter holds a Diploma in Mechanical Engineering from the University of Applied Science in Regensburg with specification in Energy Technology as well as a Master of Science in Water Resource and Environmental Engineering from University of Duisburg-Essen.

Table 2-1 Validation team member

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)	Involvement in			
						Desk/Doc review	On-site inspection[1]	Interview(s)	Verification findings
1.	Team Leader	IR[2]	Winter	Stefan	TÜV NORD CERT GmbH	☒	☒	☒	☒

Table 2-2 Technical reviewer and approver

No.	Role	Type of resource	Last name	First name	Affiliation
1.	Technical reviewer /Approver	IR	Stöhr	Christina	TÜV NORD CERT GmbH

Refer to Appendix 1 for Statement of Competence of team members and technical reviewer.

[1] Remote audit via MS Teams

[2] IR = Internal Resource; EI = External Individual

2.5 Resolution of Findings

Material discrepancies identified in the course of the validation are addressed either as CARs, CLs or FARs.

A Corrective Action Request (CAR) is established where:

- The project participant made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions;
- The VCS requirements have not been met;
- There is a risk that the emission reductions cannot be monitored or calculated.

A Clarification Request (CL) will be issued where information is insufficient, unclear or not transparent enough to establish whether a requirement is met.

A Forward Action Request (FAR) will be issued when certain issues related to project implementation should be reviewed during the next verification.

A detailed list of the CARs CLs and FAR raised and discussed in the course of this verification is included in Appendix 4 of this report.

3 ASSESSMENT FINDINGS

3.1 Relationship to Approved or Pending Methodologies

The new proposed methodology makes reference to the following list of similar methodologies:

Table 1: Similar Methodologies

Methodology Ref. Nbr.	Title	GHG Program	Comments
AMS-III.E	Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment	Clean Development Mechanism (CDM)	Refuse derived fuel and stabilized biomass produced is used for combustion.
AMS-III.K	Avoidance of methane release from charcoal production	Clean Development Mechanism (CDM)	Only applicable to processes that improve

			charcoal production processes
AMS-III.L	Avoidance of methane production from biomass decay through controlled pyrolysis	Clean Development Mechanism (CDM)	Only includes biogenic waste biomass that was subjected to decay under clearly anaerobic conditions. Does not include provisions to utilize stabilized biomass obtained from pyrolysis.
AMS-III.BG	Emission reduction through sustainable charcoal production and consumption	Clean Development Mechanism (CDM)	Charcoal produced from renewable biomass must replace charcoal produced from non-renewable biomass (energy source)
-	General methodology for quantifying the greenhouse gas emission reduction from the production and incorporation into soil of biochar in agricultural and forest management systems	Verified Carbon Standard (VCS)	Carbon methodology (inactive)

Besides, the following related methodologies have been identified:

Methodology Title	GHG Program	Assessment
Methodology for Biochar Projects v1.0	American Carbon Registry (ACR)	This methodology is not any longer in the current list of approved methodologies under the ACR as per check of related webpage: Approved Methodologies — American Carbon Registry
Rules and Methodologies v2.0	Puro.earth	Carbon methodology- Trading platform and Certification
Carbonfuture Sink Certification Standards v1.3	Carbonfuture	Carbon methodology- Trading platform and Certification

Further, VVB has checked the following standards and registries on similar methodologies:

Standard/Registry	Related webpage
American Carbon Registry	https://americancarbonregistry.org/
Alberta Offset Registry	https://www.csaregistries.ca/albertacarbonregistries/home.cfm

Climate Action Reserve	http://www.climateactionreserve.org
UNFCCC Clean Development Mechanism	http://cdm.unfccc.int
Gold Standard for Global Goals	https://www.goldstandard.org/
Global Carbon Council	https://www.globalcarboncouncil.com/

CDM provides the following methodologies related to charcoal production or use:

- AM0082: Use of charcoal from planted renewable biomass in a new iron ore reduction system --- Version 2.0
- ACM0021: Reduction of emissions from charcoal production by improved kiln design and/or abatement of methane --- Version 1.0.0
- AMS-III.K.: Avoidance of methane release from charcoal production --- Version 5.0
- AMS-III.BG.: Emission reduction through sustainable charcoal production and consumption --- Version 3.0

A typical project activity under AM0082 would be the replacement of fossil fuel based charcoal by renewable produced charcoal, biochar, in the iron ore production. Further, the methodology requires that the biochar is produced from dedicated plantations only. In contrast this newly proposed methodology allows the production of biochar from biomass sourced from renewable waste only and not by dedicated plantations. Hence, it is not reasonable and plausible to revise methodology AM0082 for the intended project activity as per the newly proposed methodology.

ACM0021 does not refer to charcoal production but is based on energy efficiency measures of the technology at which charcoal is used and hence not applicable for revision to consider the type and nature of typical projects as per this newly proposed methodology.

AMS-III.K. refers only to the avoidance of methane at the production process of charcoal, which is produced, from fossil raw material coal and not from renewable sources/biomass. Hence also not applicable for revision to consider the type and nature of typical projects as per this newly proposed methodology.

As per check and assessment above, no further similar methodologies have been identified and the list of all similar methodologies as per provided new methodology is considered complete and no further similar methodology could have been reasonably revised to meet the objective of the current Methodology, and thus, the current Methodology is justified.

3.2 Stakeholder Comments

The project has been published by VERRA for public commenting. 43 persons have provided 224 comments to the methodology. Very detailed and specific comments have been provided by the stakeholders. Based on the comments received the methodology has been updated as applicable. All comments have been listed and all comments have been considered and provided with a response. Due to the high number of comments, please refer to Appendix 2 for list of comments, resulting changes applied and assessment by DOE.

Overall, all comments have been considered and due account has been taken. Hence, the stakeholder comments have been adequately considered or addressed.

3.3 Structure and Clarity of Methodology

Based on the methodology check, background investigation and interview with methodology developers, the assessment team has checked whether the methodology is written in a clear, logical, concise and precise manner. Therefore, it can be conclude that:

- the developer has followed the instructions in the methodology template and ensured that the methodology's various criteria and procedures are documented in the appropriate sections of the template.
- the terminologies used in the methodology are consistent with that used in the VCS Program, and GHG accounting generally.
- the key words "must", "should" and "may" have been used appropriately and consistently to denote firm requirements, (non-mandatory) recommendations and permissible or allowable options, respectively.
- the criteria and procedures are written in a manner that can be understood and applied readily and consistently by project proponents.
- the criteria and procedures are written in a manner that allows projects to be unambiguously audited against them.

In general terms the proposed methodology is technical transparent, the technical approaches are conservative and the methodology as a whole is consistent. Overall, it is the Assessment Team's opinion that the structure of the Methodology document meets the methodological requirements of the VCS Program.

3.4 Definitions

The assessment team confirms that all key terms are defined clearly and appropriately, and are consistently used in the methodology. The related terms and definitions have been provided in the corresponding section 3. The definitions of the terms have been listed in alphabetical order, and definitions of terms already defined under the VCS Program have not been repeated in the methodology. The methodology developers decided not to include a list of the key acronyms used in the new methodology.

Applicability Conditions

The methodology provides corresponding applicability conditions. Due to the nature of the methodology and intended project activities criteria have been established for the geographical scope, the technological scope, eligibility of types of use of feedstocks for biochar production as well as criteria for end-use application of produced biochar. Further, criteria are established under which circumstances the methodology is not applicable. Hence, applicability criteria are established in general as well as which technology can be used which feedstock as well as how the biochar is allowed to be used. Therefore, the applicability conditions as a whole are sufficiently clear for determining which project activities are eligible under the methodology.

A proposed project activity must satisfy the following conditions in order for the proposed methodology to be applicable:

Applicability criteria	Assessment
Technology	
The methodology is applicable when biochar is produced from waste biomass through a thermochemical process such as pyrolysis, gasification, and biomass boilers[3] and the biochar is subsequently applied into an end-use (soil or non-soil applications). Torrefaction and hydrothermal carbonization as a process of production of biochar are excluded[4] from this methodology.	The related technical process for the production of biochar are clearly mentioned as well as which are not applicable. Further, as per technical description of a technology supplier it is easy to identify whether the proposed technology in a project activity complies with the technologies allowed under the methodology.
The methodology is applicable to projects using either low or high technology production facilities as per definition of each provided in Section 3 of this methodology.	In general, the methodology distinguishes between high and low technology production facilities. According to these criteria, a high technology production facility must comply with the definition given in related definitions section 3 of the methodology. Those are: Pyrolytic gases must be fully recovered, 70% of the heat energy produced must be used, pollution controls are in place and local, national or int. emission thresholds must be adhered to as well as

[3] For the purpose of this methodology, the terms pyrolysis, gasification and biomass boilers are used interchangeably.

[4] Both processes are excluded because do not generate solid products that are significantly more persistent in soil than the original feedstock (Woolf et al., 2021)

	the production temperature is measured and recorded. All other technologies not meeting these criteria are considered low technology production facilities as per related low technology definition of the methodology. Hence, the criteria is sufficiently clear and specific in terms of what is to be provided.
The biochar producers must have a health and safety program to protect workers from airborne pollutants and other hazards.	This criterion refers to adherence to all host country legislation w.r.t. air quality, environmental and biochar production. Additionally an operational health and safety program / plan has to be established by the biochar production facility operator. Hence, the criterion is sufficiently clear in description and what is requested.
Eligible feedstocks and production	
The feedstock used to produce biochar must meet all following conditions to be eligible: a) Feedstock must be purely biogenic waste biomass and not purpose-grown, b) Feedstock must have been otherwise left to decay or combusted for purposes other than energy production. Additional guidance on how to demonstrate fate of waste biomass in the absence of the project activity is provided in Appendix 2, c) Feedstock must not have been imported from other countries[5], and d) Feedstock must meet the sustainability conditions provided in Table 3. This table is not an exhaustive list of waste biomass examples.	This criterion defines the conditions under which a feedstock is applicable and can be used under this methodology for biochar production. Accoridngly the biomass must meet four sub-criteria as depicted. a) This criterion clearly requires that the feedstock is 100% biogenic and is not purpose grown which excludes any dedicated biomass planation, b) This criterion requires to be demonstrated that the feedstock (biogenic waste biomass) is either otherwise left for decay or combusted for purposes other than energy production e.g. field burning. As the criterion provides further guidance for related demonstration as per methodology appendix 2 it is sufficiently clear in description and what is requested. c) This criterion clearly excludes any feedstock import to be used for biochar production, d) This criterion refers to the applicable eligible biomass feedstocks. A dedicated table is included in the methodology providing details of

[5] The methodology discourages transportation of waste biomass over long distances, especially among countries and between continents.

	the corresponding category, examples of typical feedstock types and related sustainability criteria to be complied with. Hence, the criterion is sufficiently clear in description and what is requested.
Biochar made from a single or mixed eligible feedstock types must comply with the latest version of the IBI Biochar Testing Guidelines or the EBC Production Guidelines.	It is common that biochar is not produced from one single source of biomass only. Hence, this criterion allows the use of different biomass feedstocks for the production of biochar, which is reasonable and correct. The criterion further requires that any waste biomass used have to comply with IBI or EBC material standards. EBC for example provides a positive list of permissible biomass for the production of biochar6. Therefore, the criterion is sufficiently clear in description and what is requested and ensures that only eligible biomass is used for the biochar production. Hence, the criterion is sufficiently clear in description and what is requested.
The waste biomass used as feedstock to produce biochar and the resulting biochar to be utilized in soil and/or non-soil applications may be transported via different methods including ships, boats, and vehicles other than road transportation up to a distance of 200 km. However, it must only be transported by vehicles (i.e., road transportation) for distances more than 200 km as defined under CDM Tool 12: Project and leakage emissions from transportation of freight.	This applicability criterion is derived from CDM Tool 12. If the waste biomass is received from a distance >200km then this is only allowed using vehicles via road transportation. Related project and leakage emissions have to be considered as per the stated tool. Hence, the criterion is sufficiently clear in description and what is requested.
Mineral additives such as lime, rock minerals, and ash may comprise up to 10 percent of the mass when added. If the addition exceeds 10 percent on a dry weight basis, the biochar producer must present laboratory tests indicating that the final	In order to produce high quality biochar, the biochar is usually mixed with additives such as lime. This applicability criterion refers to the use of such additives and provides a limitation in order to ensure that GHG emissions reductions are claimed for use of waste biomass left for

[6] positivlist_en_2022_1_V10_1 (european-biochar.org)

product meets IBI Biochar Testing Guidelines or EBC Production Guidelines thresholds for organic and inorganic contaminants.	decay and not for the additives. The threshold of 10% is also considered by EBC for mineral however further additives are possible and hence if the 10% threshold is exceeded justification is to be provided that the final product (biochar) meets the EBC and IBI thresholds for organic and inorganic contaminants. Therefore, the criterion is sufficiently clear in description and what is requested.
Other evidence that may be used to demonstrate compliance with waste biomass sustainability criterion are biomass certification schemes such as Roundtable for Sustainable Biomaterials (RSB), International Sustainability and Carbon Certification (ISCC) or any other certification scheme approved and/or endorsed by relevant legislative body or international body such as European Union[7], CORSIA[8] and national/state governments.	This criterion defines that the sustainability criteria can be demonstrated via providing sufficient evidence of corresponding certification schemes. Those include RSB and ISCC specifically but also any further other certification scheme approved by relevant legislative body or international body such as European Union[9], CORSIA[10], and national/state governments. Hence, the criterion is sufficiently clear in description and what is requested.
Eligible biochar end-use application criteria	
Biochar is eligible to be utilized and accounted for under the methodology if it is being utilized within one year of its production. Biochar is subjected to natural decay and the permanence of biochar is calculated for a period of 100 years. To adhere to the decay factor established for 100 years and prevent any decay before	This criterion is established to cover the end-use of produced biochar. The biochar produced has to be utilized within one year limiting the risk that GHG emissions are claimed for biochar produced on stock. A PP would need to set related measures ensuring that the biochar produced is also sold, e.g. that at least the same amount in a year is sold which is produced vide a mass

[7] Annex IX Directive (EU) 2018/2001 of the European Parliament and of the European Council of 11 December 2018 on the promotion of the use of energy from renewable sources. In particular, Annex 4 of the latter sets out the minimum requirements in the method for certifying waste and residues, listing them in the following categories: food-feed processing residues and waste; agricultural/forestry residues and waste; landscape care biomass; animal residues and waste; wastewater and derivatives; fats, oil and greases; others.

8 International Civil Aviation Organization (ICAO) under its Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) approves certification schemes for eligible biofuels produced from eligible biomass, to be used in international aviation as part of emissions reduction targets of the international aviation industry. Waste biomass may be certified using the schemes approved by CORSIA.

[9] Annex IX Directive (EU) 2018/2001 of the European Parliament and of the European Council of 11 December 2018 on the promotion of the use of energy from renewable sources. In particular, Annex 4 of the latter sets out the minimum requirements in the method for certifying waste and residues, listing them in the following categories: food-feed processing residues and waste; agricultural/forestry residues and waste; landscape care biomass; animal residues and waste; wastewater and derivatives; fats, oil and greases; others.

10 International Civil Aviation Organization (ICAO) under its Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) approves certification schemes for eligible biofuels produced from eligible biomass, to be used in international aviation as part of emissions reduction targets of the international aviation industry. Waste biomass may be certified using the schemes approved by CORSIA.

application, biochar must be utilized in soil or non-soil application, as appropriate, within the first year of its production.	balance. Otherwise, at verification the VVB will also need to assess if the one year criterion is fulfilled and any biochar which is not used within one of production is ineligible for claiming GHG emission reductions. Hence, this criterion is sufficiently clear in description and what is requested.
Biochar is eligible to be used as a soil amendment on land other than wetlands. Eligible land types includes cropland, grassland, or forest. Biochar can be applied either to the soil surface or subsurface. For surface application, the biochar must be mixed with other substrates such as compost or manure or digestate from anaerobic digestion. For subsurface application, the biochar can be either applied as a unique soil amendment or mixed with other substrates. For any other soil application, the biochar must comply with biochar material standards to avoid the risk of transferring unwanted heavy metals and organic contaminants to soil. Project proponents must meet the IBI "Standardized Product Definition and Product Testing Guidelines for Biochar That is Used in Soil"[11] or EBC "Guidelines for a sustainable production of biochar"[12], or relevant national regulations for avoiding soil contaminations.	This criterion is established to further specify the biochar soil end-use application. Biochar can be applied either on surface or subsurface. However, if applied on surface it has to be mixed with other material, substrates. This ensure higher efficiency of the biochar application and that it reduces e.g. flushing. For subsurface application this is not required. A PP would need to define the same in the PD and this can be assessed by onsite inspection or interview with end-users. This criterion ensures that the biochar applied in soil applications is limiting the transfer of contaminations to soil. Therefore, the PP has to demonstrate that the biochar is in compliance with the IBI "Standardized Product Definition and Product Testing Guidelines for Biochar That is Used in Soil" or EBC "Guidelines for a sustainable production of biochar", or relevant national regulations for avoiding soil contaminations. As the links to the related standard and guidelines are given and requirements to comply with is stated, this criterion is sufficiently clear in description and what is requested.
Biochar is eligible to be used in non-soil applications including but not limited to cement, asphalt, and any other application(s) where long term storage of the biochar is possible. Only biochar produced in high technology production facilities, as	Methodology allows the non-soil application of the biochar if it is possible that the biochar is stored on long-term basis. This criterion further clearly requires that the biochar had to be produced in a high technology production facility. This can be demonstrated and assessed easily. In consideration with the next applicability

[11] Available at https://www.biochar-international.org/wp-content/uploads/2018/04/IBI_Biochar_Standards_V2.1_Final.pdf
[12] Available at https://www.european-biochar.org/biochar/media/doc/ebc-guidelines.pdf

defined under the methodology, is eligible to be used in non-soil applications.	criterion which requires peer reviewed literature to support the long-term storage, this criterion is sufficiently clear in description and what is requested.
Project proponents must demonstrate that biochar and/or final products are long-lived via credible evidence such as laboratory results, peer reviewed research papers or any other third party-evaluated product assessment, such as decay rate analysis, as applicable. The information provided must include the lifetime of the product in which biochar is stored long term. The resultant product must be compliant with national/international product quality standards/specifications as applicable (e.g., the American Concrete Institute Standards in the US).	PP would need to demonstrate that the biochar and/or the final product in which it is mixed into are long-lived. This can be evidenced by using peer-reviewed literature or any other third party evaluated product assessment, a decay rate analysis. Further, PP must provide the lifetime of the final product. Hence, this criterion is sufficiently clear in description and what is requested.
A project is not applicable if	
The methodology must not be applied if biochar is used for energy purposes, burned as a fuel (*e.g.,* as a substitute for charcoal or coke) or used in other soil or non-soil applications where biochar cannot be demonstrated as a long-lived and persistent carbon sink. Permanence through eligible utilization of biochar must be documented accordingly.	This criterion ensures that the produced biochar has to be applied in a long-lived and persistent carbon sink. This ensures that the covered carbon in the biochar is extracted from atmosphere for a long period and not released again after several years. This criterion is sufficiently clear in description and what is requested.
Biochar must not be used in applications in which substantial amounts of the biochar are oxidized (e.g., burned or used as a reduction agent in steel production, processed into activated carbon, or other uses that are fossil fuel-intensive.)	This criterion ensures that the produced biochar shall not be used in processes which oxidized the biochar even in parts. Related documented evidence has to be provided. This criterion is sufficiently clear in description and what is requested.
Non-soil applications are ineligible under the methodology if there is a loss of more than 50% of the carbon measured by dry weight basis (*e.g.,* some activated carbons due to the excessive fossil fuel input result in a loss of more than 50% of the original biochar	This criterion ensures that no project activity is claiming GHG emission reductions under this methodology, which applies the biochar in non-soil application if there is a loss of more than 50% of the carbon measured by dry weight basis. This can be justified by measurements conducted by the PP in trials or based on literature or studies.

carbon material and therefore, would not be eligible).	Hence, this criterion is sufficiently clear in description and what is requested.

3.5 Project Boundary

The methodology defines the project boundary as the spatial extent of the project boundary encompasses the geographic area where:

a) initial waste biomass is sourced;
b) waste biomass is treated through the eligible thermo-chemical technologies for the purpose of production of biochar; and
c) the final application of biochar in soils or non-soils occur;

This is illustrated in the methodology as per following Figure.

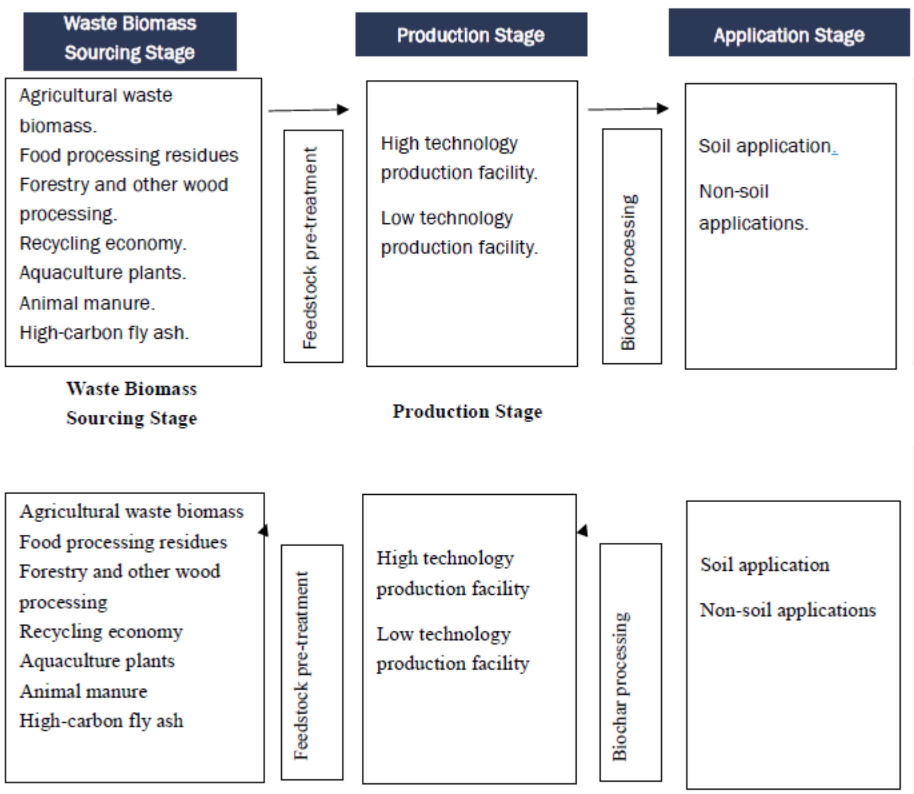

Figure 1: Project boundaries

Further, the methodology provides a table of corresponding GHG sources, sinks and reservoirs, whether they are included or not and a corresponding justification.

The project boundary has been assessed as adequate in the context of the considered typical project activities. All relevant GHG emission sources have been identified, assessed and corresponding justification for inclusion or exclusion has been provided.

The provided figure is a clear and correct as well as appropriate delineation of typical project activities under the methodology.

3.6 Baseline Scenario

The baseline scenario is where in the absence of project activity, waste biomass is either left to decay or combusted for purposes other than energy production, and is not utilized for producing biochar for either soil and/or non-soil application.

The methodology further requires providing credible evidence of the baseline scenario of waste biomass and also provides examples of those such as but not limited to annual government records, records of a waste disposal facility, records of production facility among others. Are those not available the project proponent must utilize data from existing literature, existing survey data of similar industries in the same region, or conduct its own survey.

The baseline scenario is hence predefined and any project activity has to provide evidence complying with the baseline scenario. A related applicability criterion is established. This ensures that project activities that are not applicable to the related criterion w.r.t. eligible feedstock and production cannot apply the methodology. The related criterion requires that either one or both of the following must be fulfilled:

- waste biomass utilized as feedstock would have been otherwise left to decay.
- waste biomass utilized as feedstock would have been otherwise combusted for purposes other than energy production.

3.7 Additionality

The Methodology uses a project method for additionality demonstration. The Methodology requires the project to demonstrate additionality via regulatory surplus in accordance with the VCS Methodology Requirements. To demonstrate additionality, a project activity under this methodology must pass the following two-step approach:

Step 1: Regulatory surplus

The project proponent must demonstrate regulatory surplus in accordance with the rules and requirements regarding regulatory surplus set out in the latest version of the VCS Standard and VCS Methodology Requirements.

Step 2: Positive List

The applicability conditions of this methodology represent the positive list. The project must demonstrate that it meets all of the applicability conditions, and in doing so, it is deemed as complying with the positive list. The positive list was established using the activity penetration option (Option A in the VCS Methodology Requirements). A related justification for the activity method and a step-by-step explanation is provided in Appendix 1 of the proposed methodology. The Activity Penetration option as described in the methodology is as following:

Activity Penetration

Per the *VCS Methodology Requirements* (section 3.5.9 Option A (c))[13], Verra will reassess whether the activity penetration levels remain within the permitted threshold within three years of the initial approval of the methodology.

Activity penetration is calculated as:

$$AP_y = \frac{OA_y}{MAP_y}$$

Where:

AP_y	Activity penetration of the project activity in year y (percentage)
OA_y	Observed adoption of the project activity in year y
MAP_y	Maximum adoption potential of the project activity in year y

MAPy:

The United Nations Food and Agricultural Organization's (FAO) online FAOSTAT[14] database of forestry and agricultural statistics was queried for the total amount of "wood residues". Results indicated that in 2019, there were 336,858,637 cubic meters of wood residues reported by 94 countries worldwide in 2019 (country reporting includes the US, China, UK, Switzerland, as well as many others in the Global South). Wood residues can be in different forms (from sawdust and other wood residues at sawmills to slash piles in the forest to firewood). According to the UK Forest Research agency:

- Industrial roundwood averages 1.43 cubic meters per tonne for softwoods and 1.25 cubic meters for hardwoods.
- Chips and sawdust are 1.48 cubic meters per tonne.
- Fuelwood is 1.38 cubic meters per tonne.

For the sake of conservativeness, by taking the least dense metric of 1.25 cubic meters per tonne there are an estimated 269,486,910 tonnes of wood residues produced globally on an annual basis[15].

The same database did not have any similar information on "crop residues", however it did report total tonnes of crops produced globally. The value in 2019 was 11.9 billion tonnes of total crops. To be conservative, if only 10% of that value was crop residues, it would be over 1.1 billion tonnes a year (globally) potentially available for conversion to biochar.

Adding 269,486,910 tonnes of wood residues to 1.1 billion tonnes of crop residues = 1,369,486,910 tonnes.

[13] Available at https://verra.org/wp-content/uploads/2019/09/VCS_Methodology_Requirements_v4.0.pdf
[14] FAOSTAT. 2021. Web query. http://www.fao.org/faostat/en/#data
[15] Available at https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/forestry-statistics-2016-introduction/sources/timber/conversion-factors/

Therefore, for the purposes of this methodology, the maximum adoption potential of this activity is limited to MAPy = 1.369 billion tonnes.

VVB has assessed the values above and found them consistent with the related source and in line with the requirements as per *VCS Methodology Requirements* v4.1 which defines MAP as “the total adoption of a project activity that could currently be achieved given current resource availability, technological capability, level of service, implementation potential, total demand, market access and other relevant factors within the methodology’s applicable geographically defined market.

OAy:

According to the International Biochar Initiative[16], in 2015 a total of 85,000 tonnes of biochar was transacted globally.

Methodology developer, to be conservative, assumed that the 2015 IBI report only captured half of the reported transaction volumes meaning that 170,000 metric tonnes of biochar was produced.

As per methodology, since the last IBI biochar report was published, China has begun to produce a significant amount of material. As of 2019, China was producing 500,000 metric tonnes a year (T.R. Miles pers. comm). According to the National Alliance of Biochar Science and Technology Innovation in China, the country plans to reach 3,000,000 tonnes per year of biochar production in the coming years.

Using 170,000 metric tonnes (based on 2015 IBI data) and an assumed growth rate of ten percent per year for 2016 to 2021, gives 273,787 metric tonnes for all countries excluding China. Adding 500,000 tonnes to account for China’s production the total 2021 global estimate of biochar on an annual basis is 773,787 metric tonnes.

VVB has checked the values and found them consistent with the sources. Hence, the global APy is determined as following:

Global APy calculation for biochar

Therefore, the Global APy for biochar is:

$$AP_y = \frac{OA_y}{MAP_y}$$

$$AP_y = 773{,}787 \,/\, 1{,}369{,}486{,}910$$

$$AP_y = 0.06\%$$

$$AP_y = < 5\%$$

Given the current level of biochar production and waste biomass annually available, it is demonstrated that the activity level of penetration of the project activity covered by this

16 State of the Biochar Industry. 2015. International Biochar Initiative. https://biochar-international.org/state-of-the-biochar-industry-2015/

methodology is below the five percent threshold, and the project activity may be deemed additional.

If the project activity has been commercially available in any area of the applicable geographic scope for less than three years, it shall be demonstrated that the project activity faces barriers to its uptake. Such barriers shall be demonstrated in accordance with Step 3 (barrier analysis) of the latest version of the CDM *Tool for the demonstration and assessment of additionality*. The analysis of commercial availability shall be conducted at the national level and shall assess the time period over which biochar made from waste biomass is available for commercial purchase in the project region

The Assessment Team reviewed the procedure for proving additionality and issued Findings, as necessary. The final Methodology document contained an additionality procedure appropriate for corresponding typical project activities, and the Assessment Team concludes that the criteria for determining additionality is complete and in line with VCS requirements.

3.8 Quantification of GHG Emission Reductions and Removals

3.8.1 Baseline Emissions

Due to the nature of a typical project activity, GHG emissions are reduced at different stages of the supply chain. This includes

- the sourcing stage, where waste biomass is sourced and collected,
- the production stage, during which waste biomass is prepared (if applicable) and thermochemical converted into biochar and,
- the application stage, where the biochar is applied into a long term end-use (in soils or eligible non-soil applications).

GHG baseline emissions at the sourcing stage

The baseline scenario is the situation where, in the absence of the project activity, waste biomass would have been left to decay or would have been combusted for purposes other than energy production in the year that the biochar is made within the project boundary.

Following the CDM Annex 18 on "Definition of renewable biomass", waste biomass can be classified as renewable. As the decay rate pathway of diverse feedstock types varies by region and time, the methodology defines the default net baseline emission avoidance as zero following a conservative scenario ($ER_{SS,y}$).

GHG baseline emissions at the production stage

The proposed methodology is established in a way that in the baseline scenario at production stage, no biochar is produced for the purpose of the project activity and therefore no GHG removals or related emissions are considered. Hence, those emissions are considered zero.

GHG baseline emissions at the application stage

Emissions at application stage refer to GHG emissions associated with the post-production and end-use application of biochar. In the baseline scenario at application stage, since no biochar was produced, no GHG removals or related emissions are considered. Similar to the GHG baseline emissions at production stage as no biochar is produced there is no application as well and hence related baseline emissions are considered zero.

3.8.2 Project Emissions

Similar to the GHG reduction at different stages of the supply chain of a typical project activity, also project emissions are emitted at different stages. This includes the same stages as for the baseline emissions:

- the sourcing stage, where waste biomass is sourced and collected,
- the production stage, during which waste biomass is prepared (if applicable) and thermochemical converted into biochar and,
- the application stage, where the biochar is applied into a long term end-use (in soils or eligible non-soil applications).

GHG project emissions at the sourcing stage

At the sourcing stage as described above, the methodology relies on the collection of waste biomass. Therefore, the emission at the sourcing stage ($PE_{SS,y}$) are set as zero.

GHG Project emissions at the production stage

As per following equation (1) the GHG project emissions during the biochar production are determined as following:

$$ER_{PS,y} = \sum_{t}\sum_{k}\sum_{p}\left(CC_{t,k,y} \times \frac{44}{12}\right) - PE_{PS,t,p,y} \tag{1}$$

Where:

$ER_{PS,y}$	GHG emissions removals at production stage in year *y* (tCO_2e)
$CC_{t,k,y}$	Organic carbon content on a dry weight basis for biochar type *t* used for application type *k* in year *y* (tonnes)
$PE_{PS,t,p,y}$	Project emissions at production stage for production of biochar type *t* at production facility *p* in year *y* (tCO_2e)
$\frac{44}{12}$	Coefficient to convert organic carbon to tCO_2e

Further, those emissions are different for different applied technologies, either high or low technology as well as decay rates may differ depending on the related utilization and application.

GHG Project emissions at production stage for high technology production facilities

First, the related organic carbon content has to be determined for high technology production facilities. Those is determined as following:

$$CC_{t,k,y} = M_{t,k,p,y} \times F_{Cp,t,p} \times PR_{de,k} \quad (2)$$

Where:

$CC_{t,k,y}$ Organic carbon content on a dry weight basis for biochar type *t* used for application type *k* in year *y* (tonnes). Biochar type is based on the feedstock used to produce the biochar.

$M_{t,k,p,y}$ Mass on a dry weight basis of biochar type *t* for application type *k* produced at the production facility *p* in year *y* (tonnes)

$F_{Cp,t,p}$ Organic carbon content of biochar type *t* produced in production facility *p* per tonne of biochar, taken on a dry weight basis (percent). For high technology production facilities, this is defined through laboratory material analysis of biochar.

$PR_{de,k}$ Permanence adjustment factor due to decay of biochar per application type *k* (dimensionless)

Soil end-use: Biochar must have an $H:C_{org} < 0.7$. As permanence is accounted over a period of 100 years, only a fraction of the original carbon content is accounted as removal. The value is determined by production temperatures T_{prod} reported in the literature, which are considered conservative defaults for $PR_{de,k}$ as aligned with IPCC (2019) and Woolf *et al*. (2021).

Table 5: Default Values for $PR_{de,k}$ from Table 4AP.2 of IPCC (2019)

Temperature	Default Value
High temperature pyrolysis and gasification (>600 °C)	0.89
Medium temperature pyrolysis (450–600 °C)	0.80
Low temperature (350–450°C)	0.65

Further, the proposed methodology requires for non-soil end-use, if no scientifically robust information on the permanence of organic carbon content is available, project proponents must use the soil application decay factor in Table 5. PPs can also propose any other value for $PR_{de,k}$ based on credible supporting evidence. The requirements as per section 2.5.2 of latest version of the VCS Methodology Requirements have to be followed. The proposed methodology clearly states that white papers or non-peer reviewed research papers are not considered as credible and appropriate forms of evidence.

Second, the GHG project emissions for high technology production facilities are determined using the following equation:

$$PE_{PS,t,p,y} = \sum_{t} \{ (P_{ED,p,y} + P_{EP,p,y} + P_{EC,p,y}) \times \left(\frac{M_{t,k,p,y}}{\sum M_{x,p,y}} \right) \} \quad (3)$$

Where:

$PE_{PS,t,p,y}$	Project emissions at the production stage for production of biochar *t* at the production facility *p* in year *y* (tCO_2e)
$P_{ED,p,y}$	Emissions associated with the pre-treatment of waste biomass at the production facility *p* in year *y* (tCO_2e)
$P_{EP,p,y}$	Emissions associated with the conversion of waste biomass into biochar at the production facility *p* in year *y* (tCO_2e)
$P_{EC,p,y}$	Emissions due to the utilization of auxiliary energy for the purpose of pyrolysis at the production facility *p* in year *y* (tCO_2e)
$M_{t,k,p,y}$	Mass of biochar on dry weight basis of type *t* and application type *k* produced at the production facility *p* in the year *y* (tonnes), see application stage
$M_{x,p,y}$	Total mass of biochar on dry weight basis produced in the production facility *p* in year *y* (tonnes)

Project emissions associated with the pre-treatment of feedstock at the production facility *p* in year y ($P_{ED,p,y}$)

Energy consumption for any necessary pre-treatment of waste biomass must be accounted for. This can include feedstock preparation (*e.g.*, feedstock agglomeration, homogenization, pelletizing) either inside the production facility or in the field preparation, drying of wet waste biomass, or other processes. If the energy source is renewable, $P_{ED,p,y}$, must be zero. Otherwise, it must be calculated as follows:

$$P_{ED,p,y} = P_{EDE,p,y} + P_{EDF,p,y} \quad (4)$$

Where:

$P_{ED,p,y}$	Emissions associated with pre-treatment of feedstock at the production facility *p* in year *y*(tCO_2e)

$P_{EDE,p,y}$ Emissions associated with use of grid connected electricity utilized for pre-treatment of waste biomass at the production facility *p* in the year *y* (tCO_2e). $P_{EDE,p,y}$ must be calculated as per the provisions of CDM Methodological Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation[17]

$P_{EDF,p,y}$ Emissions associated with combustion of fossil fuels utilized for pre-treatment of waste biomass at the production facility *p* in the year *y* (tCO_2e). $P_{EDF,p,y}$ must be calculated as per the provisions of CDM Tool 03 to calculate project or leakage CO_2 emissions from fossil fuel combustion[18]

Project emissions associated with the thermochemical process (pyrolysis) at the production facility *p* in year y ($P_{EP,p,y}$) for high technology facilities

Processing of the waste biomass refers to the pyrolysis process, which fixed the organic carbon from biomass into permanent carbon in the biochar. The respective value $P_{EP,p,y}$ accounts for the emissions from the pyrolysis, which are emitted into the atmosphere. In alignment with eligibility requirements for high technology production facilities[19], net emissions are considered *de minimis*. Therefore,

$$P_{EP,p,y} = 0$$

Where:

$P_{EP,p,y}$ Emissions associated with the conversion of waste biomass at the production facility *p* into biochar in year *y* (tCO_2e)

Project emissions due to the utilization of auxiliary energy for the purpose of pyrolysis at the production facility *p* in the year *y* ($P_{EC,p,y}$)

When external energy is required to initiate and maintain the pyrolysis reactor, it must be accounted as project emissions. If the source of auxiliary energy is renewable, $P_{EC,p,y}$ must be zero. Otherwise, it must be calculated as follows:

$$P_{EC,p,y} = P_{ECE,p,y} + P_{ECF,p,y} \quad (5)$$

Where:

$P_{EC,y,p}$ Emissions due to the utilization of auxiliary energy for the purpose of pyrolysis at production facility p in year y (tCO2e)

[17] CDM Methodological Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf

[18] CDM Tool to calculate project or leakage CO2 emissions from fossil fuel combustion. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf

[19] Following requirement (a) of Option P.1: Ability to combust or recover pyrolysis gases, limiting the emissions of methane to the atmosphere.

$P_{ECE,p,y}$ Emissions associated with use of grid connected electricity utilized for starting the reactor at production facility p in the year y (tCO_2e). $P_{ECE,p,y}$ must be calculated as per CDM Methodological Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation[20]

$P_{ECF,p,y}$ Emissions associated with combustion of fossil fuels utilized for starting the reactor at production facility p in the year y (tCO_2e). $P_{ECF,p,y}$ must be calculated as per the provisions of CDM Tool 03 to calculate project or leakage CO_2 emissions from fossil fuel combustion[21]

GHG Project emissions at production stage for low technology production facilities

First, the related organic carbon content has to be determined for low technology production facilities. Those is determined as following:

$$CC_{t,k,y} = M_{t,k,p,y} \times F_{Cp,t,p} \times PR_{de,k} \quad (6)$$

Where:

$CC_{t,k,y}$ Organic carbon content on a dry weight basis for biochar type *t* used for application type *k* in year *y* (tonnes). Biochar type is based on the feedstock used to produce the biochar.

$M_{t,k,p,y}$ Mass on a dry weight basis of biochar type *t* for application type *k* produced at production facility *p* in year *y* (tonnes).

$F_{Cp,t,p}$ Organic carbon content of biochar type *t* produced in production facility *p* per tonne of biochar, taken on a dry weight basis (percent). F_{Cp} for low technology production facilities is determined through laboratory material analysis of biochar where possible. Otherwise, F_{Cp} values are obtained from Table 6 per type of feedstock. Where feedstocks are mixed, the most conservative F_{Cp} value of the relevant feedstocks must be used.

$PR_{de,k}$ Permanence adjustment factor due to decay of biochar to be defined for application type *k* (dimensionless). Biochar is subject to natural decay rate when used in soil applications such as in agriculture, forests, croplands, or grasslands. Many low technology production facilities do not measure the temperature at biochar production. A default value of 0.56[22] must be used

[20] CDM Methodological Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf

[21] CDM Tool to calculate project or leakage CO2 emissions from fossil fuel combustion. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf

[22] Value of 0.56 is used where the temperature of pyrolysis is not measured, recorded and reported. Default value taken from Figure 4Ap.1(b) in IPCC (2019) *Appendix 4: Method for Estimating the Change in Mineral Soil Organic Carbon Stocks from Biochar Amendments: Basis for Future Methodological Development*. Available at https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch02_Ap4_Biochar.pdf

where pyrolysis temperature is unknown. This follows a conservative approach for carbon permanence.

Values for organic carbon content per tonne of biochar per production type (F_{Cp})

The organic carbon content must be determined in a qualified laboratory following *IBI Biochar Testing Guidelines* or *EBC Production Guidelines* on the production of biochar. However, project proponents using low technology production facilities may adopt values from IPCC (2019) for different feedstocks and production types (Table 6). Further, project proponents may also refer to other scientific literature such as Woolf et al. (2021).

Table 6: Values for Organic Carbon Content in Biochar from Table 4AP.1 of IPCC (2019)

Feedstock	Production Process	Values for F_{Cp}
Animal manure	Pyrolysis	0.38
	Gasification	0.09
Wood	Pyrolysis	0.77
	Gasification	0.52
Herbaceous (grasses, forbs, leaves; excluding rice husks and rice straw)	Pyrolysis	0.65
	Gasification	0.28
Rice husks and rice straw	Pyrolysis	0.49
	Gasification	0.13
Nut shells, pits, and stones	Pyrolysis	0.74
	Gasification	0.40
Biosolids (paper sludge)	Pyrolysis	0.35
	Gasification	0.07

Second, the GHG project emissions for low technology production facilities are determined using the following equation:

$$PE_{PS,t,p,y} = \sum_{t} [(P_{ED,p,y} + P_{EP,p,y} + P_{EC,p,y})] \quad (7)$$

Where:

$PE_{PS,t,p,y}$ Project emissions at the production stage for production of biochar *t* at the production facility *p* in year *y* (tCO_2e)

$P_{ED,p,y}$ Emissions associated with the pre-treatment of waste biomass at the production facility *p* in year *y* (tCO_2e)

$P_{EP,p,y}$ Emissions associated with the conversion of waste biomass into biochar at the production facility *p* in year *y* (tCO_2e)

$P_{EC,p,y}$ Emissions due to the utilization of auxiliary energy for the purpose of pyrolysis at the production facility *p* in year in year *y* (tCO_2e)

Project emissions associated with the pre-treatment of feedstock at the production facility *p* in year y ($P_{ED,p,y}$) for low technology facilities

Energy consumption for necessary pre-treatment of waste biomass must be accounted for. This can include feedstock preparation (*e.g.,* feedstock agglomeration, homogenization, pelletizing) either inside the production facility or in the field preparation, drying of wet biomass, or other processes. If the energy source is renewable, $P_{ED,p,y}$ must be zero. Otherwise, it must be calculated as follows:

$$P_{ED,p,y} = P_{EDE,p,y} + P_{EDF,p,y} \quad (9)$$

Where:

$P_{ED,p,y}$ Emissions associated with pre-treatment of feedstock at the production facility *p* in the year *y* (tCO_2e)

$P_{EDE,p,y}$ Emissions associated with grid connected electricity utilized for pre-treatment of waste biomass at the production facility *p* in the year y (tCO_2e). $P_{EDE,p,y}$ must be calculated as per the provisions of CDM Methodological Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation[23]

$P_{EDF,p,y}$ Emissions associated with combustion of fossil fuels utilized for pre-treatment of waste biomass at the production facility *p* in the year *y* (tCO_2e). $P_{EDF,p,y}$ must be calculated as per the provisions of CDM Tool 03 to calculate project or leakage CO_2 emissions from fossil fuel combustion[24]

Project emissions associated with the thermochemical process (pyrolysis) at the production facility *p* in year y ($P_{EP,p,y}$) for low technology facilities

In the absence of direct emission measurements, which can reliably measure and report project emissions, the following data from the literature must be used:

$$P_{EP,p,y} = \sum_{k}\sum_{t}(F_e \times \mathrm{GWP}_{CH4} \times M_{t,k,p,y}) \quad (9)$$

[23] CDM Methodological Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation. Available at: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf

[24] CDM Tool to calculate project or leakage CO2 emissions from fossil fuel combustion. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf

Where:

$P_{EP,p,y}$ Emissions associated with the conversion of waste biomass into biochar at the production facility *p* in year *y* (tCO_2e)

F_e Average methane emissions from producing one tonne of biochar in year *y* (tCH_4/tonne). Values from Table 3 in Cornelissen et al. (2016)[25] may be used based on the corresponding kiln type (i.e., low technology production facility type). Where the kiln type is not listed a default average emission factor of 0.049 t CH_4/tonne may be conservatively used based on the value for traditional kilns since simple low-cost technologies are known to emit higher levels of CH_4[26]. Project proponent may propose more appropriate values based on scientific studies, research papers or any other credible documentation and/or information related to the utilized production technology.

GWP_{CH4} Global Warming potential of methane. Use the value referenced in the latest version of VCS standard.

$M_{t,k,p,y}$ Mass of biochar on dry weight basis of type t and application type k produced at the production facility p in the year y (tonnes)

Emissions due to the utilization of auxiliary energy for the purpose of pyrolysis ($P_{EC,p,y}$)

When external energy is required to initiate and maintain the pyrolysis reactor, it must be accounted for project emissions. If the source of auxiliary energy is renewable, $P_{EC,p,y}$ must be zero. Otherwise, it must be calculated as follows:

$$P_{EC,p,y} = P_{ECE,p,y} + P_{ECF,p,y} \quad (10)$$

Where:

$P_{EC,p,y}$ Emissions due to utilization of auxiliary energy for the purpose of pyrolysis at production facility p in year y (tCO2e).

$P_{ECE,y}$ Emissions associated with use of grid connected electricity utilized for starting the reactor at production facility p in the year y (tCO_2e). $P_{ECE,p,y}$ must be calculated as per CDM Methodological Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation[27]

$P_{ECF,y}$ Emissions associated with combustion of fossil fuels utilized for starting the reactor at production facility p in the year y (tCO_2e). $P_{ECF,p,y}$ must be

[25] Cornelissen, G., Pandit, N. R., Taylor, P., Pandit, B. H., Sparrevik, M., & Schmidt, H. P. (2016). Emissions and char quality of flame curtain “kon tiki” kilns for farmer-scale charcoal/biochar production. *PLoS ONE*, *11*(5), e0154617. https://doi.org/10.1371/journal.pone.0154617

[26] Woolf, D., Lehmann, J., Ogle, S., Kishimoto-Mo, A. W., McConkey, B., & Baldock, J. (2021). Greenhouse gas inventory model for biochar additions to soil. *Environmental Science & Technology*, *55*(21), 14795-14805.

[27] CDM Methodological Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf

calculated as per the provisions of CDM Tool 03 to calculate project or leakage CO_2 emissions from fossil fuel combustion[28]

GHG Project emissions at the application stage

As the project emissions associated with processing and utilization of biochar after its production have a potential impact on the overall emission removal potential, those emissions at the application stage are considered in the proposed methodology as per following:

$$ER_{AS,y} = \sum_{k} \sum_{t} [(-1) \times (E_{p,t,k,y} + E_{ap,t,k,y})] \quad (11)$$

Where:

$ER_{AS,y}$ GHG emissions at application stage in year *y* (tCO_2e)

$E_{p,tk,y}$ Emissions from processing of biochar type t for application type *k* in year *y* (tCO_2e)

$E_{ap,t,k,y}$ Emissions from utilization of biochar type t for application type *k* in year *y* (tCO_2e)

Project emissions associated with processing of biochar for application type *k* ($E_{p,k,y}$)

Further, the proposed methodology considers in a scenario where biochar undergoes further processing (e.g., sizing, grinding, sifting) before final soil or non-soil application, project proponents must quantify energy-related emissions associated with grinding and other mechanical treatment of biochar. This methodology does not account for emissions related to the production or generation of materials with which biochar is mixed/infused for non-soil application (e.g., biochar-amended concrete or biochar-amended asphalt).

If the energy source is renewable, $E_{p,k,y}$ is not considered and the default value of zero must be used. Otherwise, it must be calculated as follows:

$$E_{p,k,y} = P_{EPE,k,y} + P_{EPF,k,y} \quad (12)$$

Where:

$E_{p,k,y}$ Emissions from processing of biochar for application type *k* in year *y* (tCO_2e)

$P_{EPE,k,y}$ Emissions associated with grid-connected electricity utilized for processing biochar for application type *k* in year *y* (tCO_2e). $P_{EPE,k,y}$ must be calculated as per the provisions of CDM *Methodological Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation*.[29]

[28] CDM Tool to calculate project or leakage CO2 emissions from fossil fuel combustion. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf

[29] Available at: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf

$P_{EPF,k,y}$ Emissions associated with combustion of fossil fuels utilized for processing of biochar for application type *k* in year *y* (tCO_2e). $P_{EPF,k,y}$ must be calculated as per the provisions of CDM *Tool 03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion*.[30]

Where there is no processing of biochar, $E_{p,k,y}$ is zero.

Project emissions associated with utilization of biochar for application *k* ($E_{ap,k,y}$)

$E_{ap,k,y}$ corresponds to emissions during the utilization of biochar for application type k in year y. GHG emissions resulting from fossil fuel combustion or mixing of biochar with fertilizer products are considered negligible. Thus, $E_{ap,k,y}$ is zero.[31]

3.8.3 Leakage

Additional GHG emission reduction occurring outside the project boundary due to the implementation and operation of a related GHG reduction project activity under the methodology is considered leakage and has to be considered. Is this proposed new methodology applied by a typical related project activity, leakage emissions are primarily attributed to transport emissions at various stages of the biochar production life cycle. As per methodology, emissions due to activity shifting leakage or biomass diversion are considered zero, as currently only waste biomass is eligible for biochar production which is assessed as correct, reasonable and plausible.

Quantification of leakage emissions are as follows:

$$LE_y = LE_{as,y} + LE_{bd,y} + LE_{ts,y} + LE_{tap,y} \tag{13}$$

Where:

LE_y Total leakage emissions in year *y* (tCO_2e)

$LE_{as,y}$ Leakage due to activity shift in the year *y* (tCO_2e). Leakage due to activity shift is zero as purposely grown biomass is not currently allowed for production of biochar

$LE_{bd,y}$ Leakage due to biomass diversion in the year *y* (tCO_2e). Leakage due to biomass (waste/residue) diversion is considered negligible since only biomass which would have been left to decay or combusted is being utilized for biochar production

$LE_{ts,y}$ Leakage emissions due to transport of waste biomass from sourcing to the biochar production facility in the year *y* (tCO_2e). As per CDM

[30] Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf

[31] As per CDM *AR-ACM0003 Afforestation and reforestation of lands except wetlands*. Available at https://cdm.unfccc.int/methodologies/DB/C9QS5G3CS8FW04MYYXDFOQDPXWM4OE

Methodological Tool 16: Project and leakage emissions from biomass[32], GHG emissions must only be accounted for if transportation distance is 200 km or more. Project proponent must use the CDM Methodological Tool 12: Project and leakage emissions from transportation of freight[33] for calculating $LE_{ts,y}$

$LE_{tap,y}$ Leakage emissions from transportation of biochar from the production facility to the site of end application in the year y (tCO_2e). As per CDM Methodological Tool 16: Project and leakage emissions from biomass[34], GHG emissions must only be accounted for if transportation distance is 200 km or more. Project proponent must use the CDM Methodological Tool 12: Project and leakage emissions from transportation of freight[35] for calculating $LE_{tap,y}$

Emissions related to leakage from transportation of biochar from sourcing to the biochar production facility ($LE_{ts,y}$)

Project emissions from transportation of biochar from the place of origin of the waste biomass to the production site may have the following components

i. Transport emissions from field to the production facility

$LE_{ts,y}$ is considered zero if transportation distance (to and from – round trip) is less than 200 km. Calculation of project emissions from transportation of biochar must be done as per the latest version of CDM Tool12: Project and leakage emissions from transportation of freight[36].

Emissions related to leakage from transportation of biochar from production facility to site of end-use application ($LE_{tap,y}$)

Project emissions from transportation of biochar from facility to end-use application may have the following components:

i. Transport emissions biochar from facility to processing facility; AND
ii. Transport emissions processing from facility to end-use site;

OR

iii. Transport emissions from biochar facility to end-use site.

[32] CDM Methodological Tool 16: Project and leakage emissions from biomass. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-16-v4.pdf
[33] CDM Methodological Tool 12: Project and leakage emissions from transport of freight. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf
[34] CDM Methodological Tool 16: Project and leakage emissions from biomass. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-16-v4.pdf
[35] CDM Methodological Tool 12: Project and leakage emissions from transport of freight. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf
[36] CDM Methodological Tool 12: Project and leakage emissions from transport of freight. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf

$LE_{tap,y}$ is considered zero if transportation distance (to and fro) is less than 200 km. Calculation of project emissions from transportation of biochar must be done as per the latest version of CDM Tool12: Project and leakage emissions from transportation of freight[37].

Based on the interviews conducted, the documents checked as well as based on related VCS regulations the VVB confirms that the procedures for identifying and calculating leakage are appropriate for the project activities covered by the new methodology, and provide an overall conclusion regarding the procedures for calculating corresponding leakage emissions.

3.8.4 Net GHG Emission Reductions and Removals

Emission reduction at sourcing stage:

$$ER_{SS,y} = \sum_y \left(BE_{SS,y} - PE_{SS,y} \right) \quad (14)$$

Where:

$ER_{SS,y}$	GHG emissions reduction at sourcing stage in year y (tCO_2e)
$BE_{SS,y}$	Baseline emissions at sourcing stage in year y; conservatively assumed default value of zero (tCO_2e)
$PE_{SS,y}$	Project emissions at sourcing stage in year y, conservatively assumed to be zero (waste biogenic source material is considered as renewable biomass) (tCO_2e)

As per methodology the net GHG emission removals are calculated as follows:

$$ER_y = \left(ER_{SS,y} + ER_{PS,y} - ER_{AS,y}\right) - LE_y \quad (15)$$

Where:

ER_y	Net GHG emissions removals in year *y* (tCO_2e)
$ER_{SS,y}$	GHG emissions removals at sourcing stage in year *y* (tCO_2e)
$ER_{PS,y}$	GHG emissions removals at production stage in year *y* (tCO_2e)
$ER_{AS,y}$	GHG emissions at application stage in year *y* (tCO_2e)
LE_y	Total leakage emissions in year *y* (tCO_2e)

Based on the interviews conducted, the documents checked as well as based on related VCS regulations the VVB confirms that the procedures for calculating net GHG emission reductions and removals are appropriate for the project activities covered by the methodology, and provide an overall conclusion regarding procedures for calculating net GHG emission reductions and removals.

[37] CDM Methodological Tool 12: Project and leakage emissions from transport of freight. Available at https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-12-v1.1.0.pdf

Hence, the VVB confirms that:

- All algorithms, equations and formulas used are appropriate and without error.
- Any uncertainties associated with the quantification of net GHG emission reductions and removals are addressed appropriately.

3.9 Monitoring

The methodology has described data and parameters available at validation that are fixed for the duration of the project crediting period and data and parameters monitored that must be monitored during the project crediting period for each verification.

All parameters which have been defined in the corresponding baseline, project and leakage emission calculation sections have been considered either as a parameter available at validation or as a monitoring parameter or is given as a default value.

The defined parameters available at validation are as follows:

Parameter	Definition	Justification
$F_{Cp,t,p}$	Organic carbon content of biochar for each biochar type t produced in the production facility p per tonne of biochar taken on a dry weight basis (%)	Either IPCC 2019 Appendix 4 "Method for Estimating the Change in Mineral Soil Organic Carbon Stocks from Biochar Amendments: Basis for Future Methodological Development" default values, values from material analysis or default values by EBC, 2012 can be applied. Values are either clearly provided, a clear reference to data is given or how those can be obtained. A related material analysis provides a good source to obtain the corresponding value. Hence, data unit, source of data, value applied, justification of choice of data or description of measurement methods and procedures applied, and purpose of data are appropriate.
$PR_{de,k}$	Permanence adjustment factor due to decay of biochar (dimensionless) to be defined as per application type k	The source of data is EBC (2020) and IPCC (2019). It is further specified that for high technology equipment data of table 6 based on IPCC 2019 are to be applied and for low technology equipment a default value of 0.56 derived from IPCC, 2019 – Figure 4Ap.1. Hence, data unit, source of data, value applied, justification of choice of data or description of measurement methods and procedures applied, and purpose of data are appropriate.
Fe	Average methane emissions from producing one tonne of biochar in the year y	Source of data is Table 3 in Cornelissen et al. (2016) from which the default value of 0.049 tCH4/tonne biochar produced for unknown low technology production facility (i.e., kiln) type If kiln type is known and represented in Table 3, corresponding values may be used for Fe is derived. This value is to be applied by any used technology.

		Hence, data unit, source of data, value applied, justification of choice of data or description of measurement methods and procedures applied, and purpose of data are appropriate.

The monitoring parameters defined in the new methodology are as follows:

Parameter	Definition	Justification
$M_{x,p,y}$	Total mass of biochar on dry weight basis produced in the production facility p in year y	The data source will be onsite measurements, monitored continuously and recorded at least monthly of the total biochar mass in tonnes. Any related measurement equipment such as weigh scales have to be calibrated as per manufacturer's specifications or at least every three years. Besides, the amount of biochar produced can be checked against related ales invoices or records Hence, data unit, source of data, description of measurement methods and procedures to be applied, frequency of monitoring/recording, QA/QC procedures to be applied, purpose of data, and calculation method are appropriate.
$M_{t,k,p,y}$	Mass of biochar on dry weight basis of type *t* and application type *k* produced at the production facility *p* in the year *y*	The data source will be onsite measurements monitored continuously and recorded at least monthly of the biochar mass in tonnes on dry basis. Any related measurement equipment such as weigh scales have to be calibrated as per manufacturer's specifications or at least every three years. Besides, the amount of biochar produced can be checked against related ales invoices or records. Hence, data unit, source of data, description of measurement methods and procedures to be applied, frequency of monitoring/recording, QA/QC procedures to be applied, purpose of data, and calculation method are appropriate.
$F_{Cp,t,p}$	Organic carbon content of biochar for each biochar type *t* produced in the production facility *p* per tonne of biochar taken on a dry weight basis	The organic content in % is sourced from corresponding lab material analysis. The related guidelines by IBI and EBS have to be followed which require analysis on regular basis. Hence the related shall be ● annually ● after a material change in feedstock; or, ● after a material change in thermochemical production parameters; or Whichever is more frequent. Finally, the lab conducting the analysis has to be accredited and/or approved by the relevant national agency. The monitoring section allows for low technology the use of default vales as per table 6 of the methodology in case it is not possible to analyse the carbon content. Hence, data unit, source of data, description of measurement methods and procedures to be applied, frequency of monitoring/recording, QA/QC

		procedures to be applied, purpose of data, and calculation method are appropriate.
T_{prod}	Average annual production temperature during the pyrolysis process	In order to determine parameter PR_{de}, the temperature in °C has to be monitored. Hence, this parameter is introduced. Related data records of the biochar production are the source for this parameter and related instruments with recordable signal have to be used e.g. thermocouple, thermo resistance or any other instrument as prescribed by relevant international or national standards. Data has to be monitored continuously and aggregated to an annual average. Periodic calibration as against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications. This is in line with similar tools as per CDM e.g. tool 08 for parameter T_t. Hence, data unit, source of data, description of measurement methods and procedures to be applied, frequency of monitoring/recording, QA/QC procedures to be applied, purpose of data, and calculation method are appropriate.
$H:C_{org}$	Ratio of hydrogen to organic carbon	Ratio of hydrogen to organic carbon is sourced from corresponding lab analysis. The related guidelines by IBI and EBS have to be considered and the ratio has to be obtained for each batch produced. Finally, the lab conducting the analysis has to be accredited and/or approved by the relevant national agency. Hence, data unit, source of data, description of measurement methods and procedures to be applied, frequency of monitoring/recording, QA/QC procedures to be applied, purpose of data, and calculation method are appropriate.
Biomass categories and quantities used for the selection of the baseline scenario and production of biochar utilized in	- Category (*i.e.*, bagasse, rice husks, empty fruit bunches, agriculture waste etc.); - Source (*e.g.*, produced on-site, obtained from an identified biomass residues producer, obtained from a biomass residues market, etc.); - Fate in the absence of the project activity; - Documentation with sustainability criteria compliance for respective category as indicated in Table 3. Explain and document transparently in the PDD,	As different biomass waste categories in tonnes may be used for the production of biochar those need to be monitored. This is required to be done and related weights for each category etc has to be obtained. As the moisture content may vary over time and categories the weight ha to be adjusted by the moisture for dry biomass category weights. As biomass is received continuously, the parameter is to be monitoring continuously and aggregated at least to monthly values. Further, as a QA/QC measure the quantities can be cross-checked the measurements with an annual energy balance that is based on purchased quantities and stock changes. These are approaches similar to UNFCCC CDM Tool 16 for parameter $BR_{PJ,n,y}$ "Quantity of biomass residues of category n used in facilities which are located at the project site and included in the project boundary in year y".

the project activity	which quantities of which biomass categories are used in which installation(s) under the project activity and what is their baseline scenario. Include the quantity of each category of biomass (tonnes). For the selection of the baseline scenario, at the validation stage, an ex-ante estimation of these quantities should be provided	Hence, data unit, source of data, description of measurement methods and procedures to be applied, frequency of monitoring/recording, QA/QC procedures to be applied, purpose of data, and calculation method are appropriate.
WS_{pj}	Fraction of total waste heat utilized at the biochar production facility *p*	The fraction of total waste heat utilized at the biochar production facility in % is required to determine if the used technology can be categorized either as low or high technology. The definition of high technology production facility for the conditions must be met for the production facility to qualify as high technology. Hence, it is required to monitor this parameter.

Besides, the above stated parameters to be monitored the methodology also requires a project developer to develop and apply a monitoring plan according to ISO 14064-2 principles of transparency and accuracy. Besides, in case the methodology is applied in a project with a large number of instances at least one geodetic coordinate shall be provided, together with sufficient additional geographic information (with respect to the location of the instances) to enable sampling by the validation/verification body.

Further, as the end-use application of the produced biochar could be a large variety hence monitoring of the same can be challenging. Hence, as per box 1 the methodology provides further instructions and guidance of information sources for record and monitor the project activity. This could be

- Tracking records, mobile or desk application, QR code, blockchain technology, NFT (non-fungible token), GPS use-location coordinates, and any other tracking software that allows for chain of custody record generation from the sourcing stage (*i.e.,* waste biomass origination) to the end-use application of biochar in soils

The monitoring section of the methodology requires a project developer further to have an offsite electronic back-up of all logged data as well as information on biochar batch number, quantity, type of application, geographic location, and proof that the biochar will not be burned or pyrolyzed.

Furthermore, the methodology requires that the monitoring plan must contain as a minimum the following information:

- A description of each monitoring task to be undertaken, and the technical requirements therein;
- Type of technology for producing biochar;
- Written logs of operation and maintenance of the project system;

- Roles, responsibilities and capacity of monitoring team and management

As well as Project proponents must also develop a QA/QC plan to add confidence that all measurements and calculations have been made properly. QA/QC measures that may be implemented include, but are not limited to:

- Protecting monitoring equipment (sealed meters and data loggers) where applicable;
- Protecting records of monitored data (hard copy and electronic storage);
- Checking data integrity on a regular and periodic basis;
- Comparing current estimates with previous estimates as a ‘reality check’;
- Providing sufficient training to personnel to perform activities related to the sourcing, production and application of biochar

Finally, the methodology in line with VCS rules requires a PP to store documents and records in a secure and retrievable manner for at least two years after the end of the project crediting period.

After assessing corresponding methodology, underlying documents as well as by conducted interviews the VVB confirms that the data, parameters and procedures for monitoring are appropriate for the project activities covered by the methodology, and provide an overall conclusion regarding the data, parameters and procedures for monitoring.

4 ASSESSMENT CONCLUSION

TÜV NORD CERT GmbH has completed the first assessment of the corresponding VCS Methodology entitled “METHODOLOGY FOR BIOCHAR UTILIZATION IN SOIL AND NON-SOIL APPLICATIONS” version 1 dated 22/04/2022. The assessment team confirms the methodology adheres to the criteria established for this assessment, which are documented and complete. TÜV NORD CERT concludes without any qualifications or limiting conditions that the methodology documentation meets the requirements of the VCS Program Guide v4.1, VCS Standard v4.2, and the VCS Methodology Approval Process v4.1. Therefore, TÜV NORD CERT recommends Verra to approve the methodology entitled “Methodology for biochar utilization in soil and non-soil applications” as prepared by the Consortium: FORLIANCE, South Pole, and Biochar Works. In joint collaboration with Delaney Forestry Services.

5 EVIDENCE OF FULFILMENT OF VVB ELIGIBILITY REQUIREMENTS

TUV has achieved accreditation as DOE for validation and verification of UNFCCC Sectoral Scopes 1 – 16. (Please refer to *http://cdm.unfccc.int/DOE/list*). Further, TUV is accredited as per ISO 14065.

TUV has currently undertaken more than 4000 validations / verifications / determinations in the framework of JI / CDM and VO projects.

The list with details of the UNFCCC projects, which have been validated or verified, is available at *http://cdm.unfccc.int/*.

TÜV NORD CERT GmbH is appointed as VVB under VCS for all scopes 1-15, *TÜV Nord Cert GmbH - Verra.* This methodology is related to scope 13 Waste Handling and Disposal. As per following table, it is evidenced that TÜV NORD CERT has conducted more than 10 project validations under Scope 13:

Table: List of conducted project validations under Scope 13 (excerpt):

Project Name (Short)	Proj.-year	Scheme	VAL/ VER	Scheme-No.	Meth	Scope	Host Country
SD Biosupply VCS 4thVER	2021	VCS	VER	VCS416	AMS-III.H, AMS-I.C.	1, 13	Thailand
SD Biosupply VCS 3rdVER	2021	VCS	VER	VCS416	AMS-III.H, AMS-I.C.	1, 13	Thailand
ABC GS VPA6 3rd VER	2021	GS	VER	GS5801	TPDDTEC	1,13	Kenya
Hanbao GS1st VER	2021	GS	VER	GS3515	AMS-I.D., AMS-III.H.	1, 13	Taiwan
Biogas PoA Indonesia GS 3rd_VER	2021	GS	VER	GS1174	TPDDTEC	1, 13	Indonesia
Biogas PoA Indonesia GS 4th_VER	2021	GS	VER	GS5303	TPDDTEC	1, 13	Indonesia
Bukit Tagar 4thVER	2021	CDM	VER	2467	ACM0001	13	Malaysia
Bukit Tagar 5thVER+PRC	2020	CDM	VER	2467	ACM0001	13	Malaysia
CPT LFG 2nd VER	2020	CDM	PoA VER	PoA10004	ACM0001	13	South Africa
West African Biodigester Programme of Activities 4th VER	2020	CDM	PoA VER	PoA9977	AMS-I.E.	1, 13	Burkina Faso
PoA5979-CPA2 (PRC)	2020	CDM	Other	PoA5979	AMS-III.D.; AMS.I-F.	13, 1	Philippines
HIVOS VPA6 2nd (VER)	2020	GS	VER	GS5801	TPDDTEC	1, 13	Kenya
HIVOS VPA3 3rd (VER)	2020	GS	VER	GS4236	TPDDTEC	1, 13	Uganda
HIVOS VPA2 3rd (VER)	2020	GS	VER	GS2751	TPDDTEC	1, 13	Tansania
Joburg LFG (RCP)	2020	CDM	RCP	6797	ACM0001	13	South Africa
IDBP VPA2 3rd VER	2020	GS	PoA VER	GS1172	GS TPDDTEC	1, 13	Indonesia
IDBP VPA1 2nd VER	2020	GS	PoA VER	GS1172	GS TPDDTEC	1, 13	Indonesia
PoA5979-CPA2 (RCP)	2020	CDM	RCP	PoA5979	AMS-III.D.; AMS.I-F.	13, 1	Philippines
PoA6707 RCP	2020	CDM	RCP	PoA6707	ACM0001	1, 13	Philippines
PoA5979-CPA1 (RCP)	2020	CDM	RCP	PoA5979	AMS-III.D	1, 13	Philippines
PoA5979 (RCP)	2020	CDM	RCP	PoA5979	AMS-III.D.	1, 13	Philippines
Kamphaeng Saen East LFG 2nd VER	2019	CDM	VER	3462	ACM0001	13	Thailand
Biogas Vietnam GS 4th	2019	GS	VER	GS1083	TPDDTEC	1, 13	Viet Nam

VER							
CPT LFG (PRC_VER)	2019	CDM	PoA VER	PoA10004	ACM0001	13	South Africa
Composting in Mahajanga VCS VER	2019	VCS	VER	VCS0353	AMS III.F	13	Madagascar
Morocco LFG PoA 2nd (VER)	2019	CDM	PoA VER	PoA6568	ACM0001	13	Morocco
Univanich POME Biogas 5th VER	2017	CDM	VER	2076	AM0022	13	Thailand
Univanich TOPI Biogas 4th VER	2017	CDM	VER	2661	AMS III.H. AMS I.D.	13, 1	Thailand
Durban Bisasar LFG 5th VER	2016	CDM	VER	1921	AM0010	1, 13	South Africa
Durban Bisasar LFG 4th VER	2016	CDM	VER	1921	AM0010	1, 13	South Africa
Durban Bisasar LFG 3rd VER	2016	CDM	VER	1921	AM0010	1, 13	South Africa
Durban Mariannhill LFG 8th	2016	CDM	VER	0545	ACM0001; ASB0001	1; 13	South Africa
Durban Mariannhill LFG 7th VER	2016	CDM	VER	0545	ACM0001	13; 1	South Africa
Morocco LFG PoA 1st (VER)	2016	CDM	PoA VER	PoA6568	ACM0001	13	Morocco
Philippines Manure CPA Incl.	2015	CDM	CPA Incl.	PoA5979	AMS III.D., AMS I.F.	13; 1	Philippines
Philippines LFG CPA Incl.	2015	CDM	CPA Incl.	PoA6707	ACM0001	13	Philippines
Mahajanga Composting	2015	VCS	VER	VCS0353	AMS III.F.	13	Madagascar
BTC SB WW	2015	CDM	Other	0000	AMS III.H. AMS III.I.	13	Uganda
KBE BTSL Bukit Tagar LFG RenewCP	2015	CDM	RCP	2467	ACM0001	13	Malaysia
Aurá LFG 9th VER	2014	CDM	VER	0888	ACM0001	13	Brazil
Manaus LFG 5th VER	2014	CDM	VER	4211	ACM0001	13	Brazil
TBEC LIG Biogas 1st VER	2014	CDM	VER	8126	ACM0014	13	Thailand
CKA Chao Khun Agro Biogas 4th VER	2014	CDM	VER	2138	AM0022	13	Thailand
Durban Mariannhill LFG 6th VER	2014	CDM	VER	0545	ACM0001	13, 1	South Africa
Modelo del Callao LFG 1st VER	2014	CDM	VER	5619	ACM0001	13	Peru

6 SIGNATURE

Signed for and on behalf of:

Name of entity: ____TÜV NORD CERT GmbH___________

Signature: ________________________________

Name of signatory: ___Mr. Stefan Winter______________

Date: _04-08-2022_________

7 APPENDIX 1: STATEMENT OF COMPETENCE

TÜV NORD Certification

Statement of Competence

Appointment and authorization according to the procedures of the TÜV NORD JI/CDM Certification Program

Mr. Stefan Winter

SCHEME	STATUS	VALID UNTIL
CDM	Senior Assessor (Validation, Verification) Technical Reviewer	2023-07-27
VCS / ISO14064-2	Senior Assessor (Validation, Verification) Technical Reviewer	2023-07-27

Authorization status for technical areas within sectoral scopes

CODE	TECHNICAL AREA
1.1	Thermal energy generation
1.2	Renewables
2.1	Energy distribution
3.1	Energy demand
4.1	Cement and lime production
4.2	Paper
5.2	Caprolactam, nitric and adipic acid
9.1	Aluminium and magnesium production
9.2	Iron, steel and Ferro alloy production
10.1	Fugitive emissions from oil and gas
13.1	Solid waste and wastewater
13.2	Manure

153 – Rev. 7 Date: 2020-07-22

TÜV NORD Certification

Statement of Competence

Appointment and authorization according to the procedures of the TÜV NORD JI/CDM Certification Program

Ms. Christina Stöhr

SCHEME	STATUS	VALID UNTIL
CDM	Senior Assessor (Validation, Verification) Technical Reviewer	2023-05-05
VCS / ISO 14064-2	Senior Assessor/ Technical Reviewer	2023-05-05

Authorization status for technical areas within sectoral scopes

CODE	TECHNICAL AREA
1.1	Thermal energy generation
1.2	Renewables
13.1	Solid waste and wastewater

200 - Rev. 8 Date: 2021-09-29

8 APPENDIX 2: LIST OF STAKEHOLDER COMMENTS

#	Section	Comment	Response 1	Verra comment 1	Response 2
1 (1)	General	I see that the methodology allows for the use of surveys to demonstrate the fate of waste biomass. But I don't see that survey can be used for other purposes. Can they?	The purpose of the survey data is to establish the typical fate of biomass in a project region. That is the only purpose of the survey as it pertains to the methodology. If there are other purposes behind the survey (e.g. price points of biomass, economics of moving it, or something else) that is fine. However, for purposes of the methodology, the survey or data should be from a credible source (as required) to establish the typical fate of waste biomass.		
1 (2)	Monitoring	We have trained tens of thousands of farmers and expect to train millions of farmers this coming year. Each farmer can make at least one tonne of biochar per year with larger farms producing many tonnes per year. We have various models for training, including training the trainers. For example, we are starting a training project in Kasese, Uganda where we train a leader at all parishes (Catholic, Anglican, Seventh Day Adventist) to train commercial farmers on these methods of making biochar. We expect 5,000 commercial farmers to be trained. We can use surveys and other sampling methods to determine the adoption rate. If this model is successful, we will implement it throughout most of Uganda, Tanzania and Malawi and then expand to other countries. I am certain that our training will result in millions of tonnes of biochar used to improve the soil on farms in Africa	Not applicable. Methodology states the guidelines for demonstrating additionality and adoption rate.		

#	Section	Comment	Response 1	Verra comment 1	Response 2
		within a couple years. Our cost for training will be a few pennies (usd) per farmer unless we provide the farmer with tongs (usd 0.05) to remove the embers. It will cost far, far more to demonstrate baseline, feedstock, etc. for each individual farmer. Can we use surveys and other broad methods to demonstrate these among a broad population?			
2 (1)	Project Boundary	Your system boundary is from feedstock to biochar, right? So can the user (farmers and forest owners in this case) sell credits for purchased biochar they put into the soil? Or has the producer tied up all that credit?	The methodology does not specify who owns project credits. However, all VCS projects require a project proponent to take responsibility for filing project documentation, taking on legal obligations to the project, and participating in third party verification. In some cases the biochar producer will be the project proponent. In other cases, the producer and the end user (a farmer, for example) may be the same person. There could also be a scenario where the end user is the project proponent. According to *VCS Registration and Issuance Process* Section 4.2.1 *"The only entities that may initiate the project registration process are the project proponent, an entity to which the project proponent has assigned sole right to the GHG emission reductions or removals for the entire project crediting period, or the authorized representative of either of these entities. No other entity can initiate the project registration process".* Overall, defining the project proponent is outside the scope of the methodology.		
2 (2)	Project Boundary	For low tech producers, they're often also the users, so it's clear they can't double dip, but I'm wondering how the credit flows when it's the end user who's actually doing the sequestration. Would the only way	See answer 2(1)		

#	Section	Comment	Response 1	Verra comment 1	Response 2
		for the buyer to participate be to bargain for a share in the credits?			
3 (1)	General	Solid waste management is becoming a major public health and environmental concern in urban and semi-urban areas of many developing cities in Kenya. The situation in Kenya, particularly in the cities like Kisumu, is experiencing a severe sanitation problem caused by poor waste management system. The public sector in many cities in Kenya, are unable to deliver services effectively, regulation of the private sector is limited and illegal dumping of domestic and industrial waste is a common practice. In general, solid waste management is given a very low priority in African countries. As a result, very limited funds are provided to the solid waste management sector by the governments, and the levels of services required for protection of public health and the environment are not attained. It is my hope that if we could partner with you to adapt the methodology employment of a broad monitoring and accounting framework that captures the GHG impacts into the three important stages of a biochar value chain, would create a positive impact in sourcing stage, production stage, and application stage ,as the applicable methodology provides a framework for the quantification of GHG benefits in the adoption of improved Waste Handling and Disposal (WHD) practices to make biochar in the final utilization of biochar in soils or non-soils	Not applicable.		

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		applications.Than you so much for this innovation hoping for the best.			
4 (1)	General (Permanence)	If carbon is stored in soils as soil organic matter resulting from certain agricultural practices, these practices have to be maintained over long time periods to ensure that carbon is being sequestered and not decomposed. In contrast, if biochar is applied to a soil, the carbon is stored at that very momoent and will stay there even if agricultural practices change. So, biochar application better addresses the problem of permanance and the carbon can be certified and traded rather early after the biochar application. Is that considered in the biochar standard under development?	Following biochar production, an IPCC value is used to determine permanence (depending on feedstock or production temperature). The IPCC value takes the annual decay of biochar when added to soils and multiplies it over 100 years. The values are therefore already adjusted for some fraction of decay that can be expected to occur in out years during the year one calculations. Please refer to the methodology for the values to be used.		
4 (2)	Applicability Conditions	We understand that the standard intends to only accept waste biomass, in order to make sure that biochar production does not displace other land uses and leads to degradation of other ecosystems. Though, we'd propose to use the wording of residual biomass instead so that crop residues or residues from pruning of agroforestry trees can be included and certified as well. As for woody biomass the standard could demand that only woody biomass from trees on farm can be used.	The scientific literature is filled with different terms for waste biomass for different sectors, including residual biomass, crop residues, logging debris, paper mill waste, mill residues, manure, and biosolids (to name a few). The methodology uses “waste biomass” to describe a broad class of materials across sectors; using “residual biomass” is too narrow given the variety of feedstocks eligible under the methodology. Further, crop residues and/or agroforestry residues is included. Please refer to Section 4, Applicability Conditions in the methodology for more details on the eligible feedstocks.	Could also refer to the definition of Waste Biomass in Section 3 Definitions	The scientific literature is filled with different terms for waste biomass for different sectors, including residual biomass, crop residues, logging debris, paper mill waste, mill residues, manure, and biosolids (to name a few). The methodology uses “waste biomass” to describe a broad class of materials across sectors; using “residual biomass” is too narrow given the variety of feedstocks eligible under the methodology. Further, crop residues and/or agroforestry residues is included. Please refer to Section 4, Applicability Conditions in the methodology for more details on the eligible feedstock and sustainability criteria. Lastly, please refer to

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					Section 3 Definitions for an updated version of waste biomass
4 (3)	Applicability Conditions	With regard to low tech stoves, only tested stoves / gasifiers should be allowed to make sure that such low tech devices do not cause additional methan or other emissions, which would jeopardize the carbon storage. The Cornelissen data that the Verra standard now refers to is not appropriate for cookstoves, since it is a much more open process where higher emissions can be expected.	The methodology is attempting to accommodate the diversity and variety of biochar production methods. The Cornelissen et al. 2013 data shows that methane production in low-tech devices can be significant and therefore it shall be incorporated in the GHG accounting. In addition, the methodology currently allows the project proponent to present their own emissions ~~test~~ data or provide scientific publications that indicates their own devices burn cleaner.		
4 (4)	Applicability Conditions	A condition as follows should be included: 70% of the thermal energy produced by the pyrolysis system and which is not used within the pyrolysis system itself must be used.	In low-tech systems (particularly in rural/remote areas), utilization of 70% of the thermal energy is not practical. Having a 70% energy utilization requirement would essentially disqualify most low-tech producers. That said, methane emissions for low-tech systems is a concern. The methodology therefore provides a default value (via Cornelissen et al. 2013) which provides an incentive for cleaner low-tech system. Further, the threshold percentage has been discussed with pyrolysis experts and has been revised.		
4 (5)	Baseline Scenario	Finally, it would be helpful, if the standard could look at alternatives to biomass production. What we mean is that for example in India large amounts of crop residues are burnt which results in huge amounts of GHG emissions and fine dust. If biochar came in here, carbon would be stored, which should be eligible under this standrad.	It is unclear what the commenter means as "alternative to biomass production". Purpose grown crops are currently ineligble. However, the scenario you describe involving crop residues in India is currently eligible under the methodology. The proponent must provide evidence that the baseline scenario for the waste feedstocks is either combustion or decay. The project proponent can quantify baseline emissions in their net GHG quanti~~ti~~fication following section 8.2.1 of the methodology		

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5 (1)	Applicability Conditions	We have read the Methodology for biochar utilization in soil and non-soil applications, and we have some doubts: First, you mention that the technology to produce the biochar might be pyrolysis or gasification. In the case we use another type of technology such as hydrothermal carbonization, would the methodology be applicable?	The IPCC permanence values are based on hundreds of studies of biochar persistence in soil (over years of study). These values are the basis of the carbon benefit calculations accruing to the project activity. The key distinguishing factor of biochar material is its recalcitrance that is largely created by the temperature of production. Lower temperature material (like those produced from torrefaction or hydrothermal carbonization) are produced in lower temperature conditions hence not as recalcitrant or persistent in soil. In addition, Torrefied and Hydrothermal products are designed to be biomass energy products and thus are best suited for VCS Sectoral Scope 1 (Renewable Energy). Hydrothermal carbonization is excluded under the current methodology version.	Should note that torrefaction/HTC have been excluded in the revised version in response to these concerns. The PC version did not state anything about this.	The IPCC permanence values are based on hundreds of studies of biochar persistence in soil (over years of study). These values are the basis of the carbon benefit calculations accruing to the project activity. The key distinguishing factor of biochar material is its recalcitrance that is largely created by the temperature of production. Lower temperature material (like those produced from torrefaction or hydrothermal carbonization) are produced in lower temperature conditions hence not as recalcitrant or persistent in soil. In addition, Torrefied and Hydrothermal products are designed to be biomass energy products and thus are best suited for VCS Sectoral Scope 1 (Renewable Energy). The revised methodology version has excluded hydrothermal carbonization and torrefaction. See Section 4 Applicability Conditions - Technology scope
5 (2)	Applicability Conditions	And, in our process to produce biochar we use the organic fraction of municipal waste, but in the methodology, we can´t found something related to food waste. Our concern is if this waste can be applied to "recycling economy" or it is not acceptable due to biochar properties requirements as it must be produced only with single feedstocks?	Municipal solid waste is not allowed under the current methodology version. Food waste coming from food processing facilities is allowed. This is in line with the parameters used from IPCC.		

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6 (1)	Applicability Conditions	As regards the 70% use of the heat generated by the pyrolysis system. This condition is set on the base of and old and surpassed view of the global and local energy system evolution, and how these are going to change, as also described in IEA, IRENA, EC latest reports. In a near future (very close, according to latest Net Zero IEA report, IRENA, EU and OECD documents, etc) the energy scenario will shift towards an extremely large penetration of Variable Renewable Energies (PV, Wind): thus, renewable electricity driven pyroysis units will be more and more a realistic option. Thus, the pyrogas will find other valuable uses. From a scientific, technical and economic point of view, it cannot be assumed a priori that burning the pyrogas for the process correspond to a more sustainable biochar production. This was true in a conventional and today rather old exergy-based based approach, but not in a wind/pv centered scenario, with low electricity prices (see latest IRENA report, which shouw ranges to day between approx 5 and 2 c$/kWhe). Even if so far we have all aimed at providing the high-T heat to the pyrolysis process through the oxidation of pyrogases, it does not mean at all that this will be the most efficient and sustainable mode of operation in the coming years. Thus, this requisite should be reconsidered in your proposed methodology. As a matter of fact, domestic Heat is	The criteria has been revised to make it more clear to the project developer. The 70% energy use requirement for high tech equipment was not listed to make biochar “more sustainable”. The percentage is modeled after the European Biochar Certificate program. The energy requirement is also a feature of the PuroEarth program. Both the EBC and PuroEarth programs are based in Europe and as such comply with European laws and regulations. In our view, the 70% waste heat utilization requirement is intended to minimize the external use of fossil fuels (for example propane or heating oil) that may be needed to dry down biomass before pyrolysis occurs. The methodology (as stated in the glossary) allows the operator to show they are meeting the 70% requirement in different ways. The document is not prescriptive on how the energy is used. It can be thermal energy used to dry down feedstocks (many of the feedstocks in the approved list may have a high moisture content), or it can involve the capture of pyrolysis gases that can be distilled into bio-oil and used as an energy source. In addition, if the biochar operator converts the thermal energy to electricity (via an Organic Rankine Engine) that is entirely up to them. The methodology simply sets a 70% energy use requirement. The methodology authors are not aware of any high tech biochar systems that meet their electrical demand with solar panels or wind turbines currently. However, like any other VCS methodology, as technologies develop or conditions change with new laws or	Liz: I would recommend that we do not point to PuroEarth's approach in the response Stefan: I think it's okay to point to PuroEarth. It is referenced in Table 1 of the methodology and is common practice to reference other methodologies, even outside the VCS, when designing methodologies	The criteria has been revised to make it more clear to the project developer. The 70% energy use requirement for high tech equipment was not listed to make biochar “more sustainable”. The percentage is modeled after the European Biochar Certificate program. The 70% energy requirement was introduced by EBC to facilitate a thermal circular economy and encourage producers to reutilize waste heat energy. This value has been adopted by other programs such as Puro.earth program. Both the EBC and Puro.earth programs are based in Europe and as such comply with European laws and regulations. - In our view, the 70% waste heat utilization requirement is intended to minimize the external use of fossil fuels (for example propane or heating oil) that may be needed to dry down biomass before pyrolysis occurs. The methodology (as stated in the glossary) allows the operator to show they are meeting the 70% requirement in different ways. The document is not prescriptive on how the energy is used. It can be thermal energy used to dry down feedstocks (many of the feedstocks in the approved list may have a high moisture content), or it can involve the

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		already historically generated from excess hydropower in Norway and Quebéc. If the path of deployment of variable RES proceed as planned for the next years, many end uses will become electricity-driven by VRE. Thus, using heat from pyrogas not necessarily mean higher efficiency and/or sustainability. And from an engineer perspective, designing an electrical pyrolyser will completely change the perspective. Moreover, biochar production must not be a slave to power generation. The bioeconomy area is moving ahead very fast. Thus, condensate from pyrogas could for instance be used as biocide/biostimulants (regulation allowing), or even the entire pyrogas stream processed in syngas or even better H2. Or many other routes. Anyway, it could become soon unnecessary to burn the pyrogas to provide energy to the pyrolyser, simply because the pyrolyser already receives energy from other RES. You should then identify another way to define the sustainability of the biochar production process, keepin a medium-to-long term view on the energy sector, for instance accounting the embedded energy in the gas-derived products, or the energy value of the gas and liquid products (H2, bio-oil) derived from the pyrogas. You should refer to the chemical energy, in addition to entalpy, in the pyrogas stream. In fact, this would be also consistent	regulations, the current biochar methodology can be updated (version 2.0, version 3.0, etc.) which will hopefully mitigate the risk of the document being "born already old and will need to be surpassed very soon". Finally, the goal of the methodology is to be globally applicable and reflective of the diverse ways biochar is made across the world (both in low and high tech systems). The methodology as drafted is intended to be "technology agnostic".		capture of pyrolysis gases that can be distilled into bio-oil and used as an energy source. In addition, if the biochar operator converts the thermal energy to electricity (via an Organic Rankine Engine) that is entirely up to them. The methodology simply sets a 70% energy use requirement. The methodology authors are not aware of any high tech biochar systems that meet their electrical demand with solar panels or wind turbines currently. However, like any other VCS methodology, as technologies develop or conditions change with new laws or regulations, the current biochar methodology can be updated (version 2.0, version 3.0, etc.) which will hopefully mitigate the risk of the document being "born already old and will need to be surpassed very soon". Finally, the goal of the methodology is to be globally applicable and reflective of the diverse ways biochar is made across the world (both in low and high tech systems). The methodology as drafted is intended to be "technology agnostic".

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		with your Glossary, when you say: "ability to [..] recover pyrolysis gases", in addition to "combust". Otherwise, your methodology is born already old and will need to become surpassed very soon. Finally, in any case it not correct to use this approach to distinguish among High Tech and Low Tech technology. Please be aware that this distinction about high and low tech has never been used in EU Directives, that always keep a technology agnostic approach. This is a very strong point in all EU documents, regulations, etc.			
6 (2)	Applicability Conditions	Second important point: agroforestry schemes, catch and cover cropping, cannot be excluded from your methodology, while this constitute an essential component of EU Directives (these methods defines the most sustainable biofuel types, i.e. Advanced Biofuels as redinfed in Annex IX Part A of EU REDII). These are methods that make agriculture more sustainable, even if these cover crops are purpose-grown material. This should be treated in the current methodology, not left to future revision, as there is a clear unbalance and strong disalignment with the Renewable Energy Directive and all major EU Directions/Regulations. It would immediately create an issue in applying your methodology to EU companies subject to RED, as all major HVO producers like ENI, Total, Neste, IP, etc etc.	The methodology does not exclude waste biomass from agroforestry systems or farms that are using conservation practices such as cover cropping. The methodology incorporates a sustainable criteria to avoid displacing current sustainable agriculture land management and convert the agricultural residues into biochar. The July 2021 EU directive that is cited is a comprehensive document describing EU targets for addressing issues of climate change through (in part) promotion of biofuels. However, the use of "purpose grown crops" planted as part of biofuels programs create carbon accounting complexities (mainly related to project boundaries and potential leakage). As such, we are excluding purpose grown crops at this time. (***Note: EBC *does* allow purpose grown crops) https://ec.europa.eu/info/sites/default/files	Could reference Verra's interest in future meth revisions and/or module development to allow for purpose grown crops. Further, could add that available waste biomass streams are plentiful and already used for the majority of biochar production globally	The methodology does not exclude waste biomass from agroforestry systems or farms that are using conservation practices such as cover cropping. The methodology incorporates a sustainable criteria to avoid displacing current sustainable agriculture land management and convert the agricultural residues into biochar. Further, the feedstock sourcing categories has been revised. The waste streams from agriculture, forestry and related industries, recycling economy, animal manure, and all those listed in Table 3: Applicability Conditions are plentiful and already covered the majority of biochar production waste biomass globally. The July 2021 EU directive

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			/amendment-renewable-energy-directive-2030-climate-target-with-annexes_en.pdf		that is cited is a comprehensive document describing EU targets for addressing issues of climate change through (in part) promotion of biofuels. However, the use of "purpose grown crops" planted as part of biofuels programs create carbon accounting complexities (mainly related to project boundaries and potential leakage). (***Note: EBC *does* allow purpose grown crops). We acknowledge the potential of purpose grown feedstock and there is current interest from Verra in future methodology revision to add a module to allow purpose grown crops. https://ec.europa.eu/info/sites/default/files/amendment-renewable-energy-directive-2030-climate-target-with-annexes_en.pdf
6 (3)	Quantification of GHG Emission Reductions and Removals	Administrative burden on the project developers or operators. Too complex methodologies add up to overhead costs, that substantially reduce the financial benefits of the credits, and generate loss of interest in companies (unless these are used just to attract investors in their companies). The great advantage of Biochar approach compared to other systems (as Low ILUC certification schemes) comes from its measurable and simple nature. It is rather simple for the user to provide evidence of the sequestered carbon. Given the characterization of the	We agree that a biochar project must be cost effective to be viable. However, the methodology must be in compliance with all rules and requirements of the *VCS Standard* (including undergoing third party verification and considerations of issues such as additionality, baselines, monitoring and leakage).		

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		specific biochar type in terms of labile and fixed carbon, and known the amount of biochar deployed in soil, the quantity of recalcitrant carbon sequestered is also known. The decay rate can be taken from literature (including, but not only, IPCC). Thus, quantifying and certifing the C removal should be a relatively simple and doable operation for the economic operator. This is key for the success of any methodology: given the low value of the product, and the intrinsic properties of biochar that makes quantification of fixed carbon very easy, the certification process should base on these and be affordable as well.			
6 (4)		finally, coupling biochar from pyrolysis and gasification is a major strategic error, on a political and communication perspective. Pyrolysis is a process which aims at keeping C in the solid, and to store it in a form as stable as possible. Gasification aims at bringing the entire amount of carbon in the biomass to CO and other gases, releasing then CO2 at the very end, after the gas is used. A theoretically 100% efficient gasification plant has 0% C in the ashes! The Carbon found in ashes is actually a measure of process inefficiency. Thus, business models and Carbon impacts are completely different between pyrolysis and gasification. The interest in biochar for the gasification chain chain is mostly linked to the possibility to get rid of a waste (ashes, to be disposed off) at low cost, and "cover" process	The methodology draws from the IPCC report and published review papers on biochar, where the documents include pyrolysis and gasification as allowable biochar production methods (both are accepted as higher temperature thermochemical conversion of dry materials). Our goal with the methodology is to remain technology agnostic. The same is true as it pertains to the physical characteristics of the biochar produced (for example pore size and it's potential impact on plant-water availability after soil application), so long as the biochar meets IBI / EBC quality criteria.		

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		inefficiencies. It is not a sound and long-term vision and business scheme. Pyrolysis is a product (biochar, biooil) oriented, not energy-oriented, pathway. All the positive fundamental arguments that biochar has developed in these years and that gained such great attention are impacted by an energy-oriented view. In pyrolysis energy is a coproduct, just that. The two processes should be kept distinct. Last but not least, also because the type of char that is derived is very different, and the amount of water that can be taken as plant-available-water differs, givent he different pore sizes.			
6 (5)	General	The definition of labile Carbon, most used in biochar, is missing in the Glossary	"Labile carbon" is a term commonly associated with the rapidly oxidizing fraction of soil organic carbon. We use "fixed carbon" which is defined in the glossary as "Amount of organic carbon stored in the biochar as a mass proportion (in %) based on biochar's dry weight". The definition is more expansive because the methodology includes non-soil applications.	Fixed Carbon Content was removed from definitions in the meth. Does this response still hold?	"Labile carbon" is a term commonly associated with the rapidly oxidizing fraction of soil organic carbon.The fixed and labile carbon term has been discused and revised. Currently, the agreed term used in the methodology is "Organic carbon content on dry weight basis". The definition is more expansive because the methodology includes non-soil applications.
6 (6)		I would suggest to modify the glossary on Pyrolysis referring to "a fixed carbon rich product" (NOT RESIDUE!!!!), and not just "carbon"	The definition has been revised		
6 (7)	Applicability Conditions	Table 3, on "Examples". The examples you report for Harvest Residues are actually "agro-processing residues", not agricultural waste biomass. These categories should be maintained separated.	Comment has been addressed and the Table has been edited in line with EBC's positive list		

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6 (8)	Applicability Conditions	Table 3. On "sustainability Criteria". The proof should be charged to the agroindustry. Moreover, straw is often removed anyway and sold to the market. Finally, the possibility re-incorporate the biochar on the same field from where it was taken must be allowed.	It is up to the project proponent to present proof of complying with the sustainability criteria. It is out of the scope of the methodology to determine responsibilities within the project design. Biochar can be applied to the same field, however, the project proponent must comply with *VCS Methodology Requirements* and *VCS Standard* guidelines when claiming carbon credits from multiple project activities (e.g., biochar and SOC). Please see *VCS Standard v4.1* Section 3.5.2 for additional guidance on applying more than one methodology at a project site.	The second half of this response re application to the same field may be unnecessary. I don't think the questioner is asking about multiple C project activities. There is no rule that biochar cannot be applied to the same sites where feedstock was sourced.	It is up to the project proponent to present proof of complying with the sustainability criteria. It is out of the scope of the methodology to determine responsibilities within the project design. There is no rule that biochar cannot be applied to the same sites where feedstock was sourced.
6 (9)	Applicability Conditions	Table 3. On Forestry and other wood processing. When you say "but limited to" should instead be "but NOT limited to"	Current version says "*..is not limited to sustainable.." .*		
6 (10)	Applicability Conditions	Page 11: add "Digestate from Anaerobic Digestion" to "such as compost or manure". This is much more sustainable approach than manure, for instance.		Missing response	Digestate from anaerobic digestion has been added in the corresponding section.
6 (11)	Baseline Scenario	Page 15. On Determination of fate of waste biomass. Please refer to "GHG emissions" and not just "methane" emissions, as this is the correct ref. It is also consisten with your Eq.2 and the definition of units for BED and BEC.	The term GHG emission has been revised and adopted.		
6 (12)	Quantification of GHG Emission Reductions and Removals	Page 29. Your statement "GHG emissions resulting due to fossil fuel combustion and fertilizer application are considered negligible." is a very rude approximation, inconsistent with actual agriculture.	Indicating Eap = 0 reflects the reality that the application of biochar will not cause additional emissions compared to the baseline of land management and fertilizer application. These emissions are outside of the system boundary as Eap refers only to the biochar-application specific emissions. A more precise wording has been added		
7 (1)	Applicability Conditions	Given the urgency of the climate crisis, we strongly recommend that you include crops grown for	Please refer to comment 6.2. Purpose-grown biomass is currently not included in the methodolgy as it adds complexities		

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		renewable energy and/or chemicals, plus biochar as eligible for carbon credits as soon as possible. Time to scale is of paramount importance. We believe that purpose grown crops present the fastest way to achieve CDR scale, cost effectively, with existing technology, and with numerous co-benefits. In short, biochar made from the pyrolysis of purpose grown crops is among the most promising natural climate solutions available. See full argument here	regarding baseline scenario, monitoring, carbon accounting, leakage, other. However, the methodology has been designed in a way that allows the inclusion of new modules/tools. Further responses are directly in the document.		
8 (1)	Applicability Conditions	I just want to clarify that projects that utilize waste energy or heat are not permitted at all? Or do they just not get carbon credit for the use of the waste heat or energy? Waste heat and energy should be utilized and therefore should be encouraged. That we waste so much energy is a big part of the problem. We should strive for more efficient systems.	Project activity is the application of biochar either in soil or non-soil applications. Quantification of energy/ waste heat for generation of carbon credits is out of the scope of the current methodology. Project proponents are allow to use more than one sectoral scope methodology in their projects following VCS Program requirements on double accounting and establishing project boundaries. Please see *VCS Standard v4.1* Section 3.5.2 for additional guidance on applying more than one methodology at a project site.	Should you say something in this response about the 70% requirement for hi tech systems?	Project activity is the application of biochar either in soil or non-soil applications. Quantification of energy/ waste heat for generation of carbon credits is out of the scope of the current methodology. The 70% energy requirement was introduced by EBC to facilitate a thermal circular economy and encourage producers to reutilize waste heat energy. In our view, the 70% waste heat utilization requirement is intended to minimize the external use of fossil fuels (for example propane or heating oil) that may be needed to dry down biomass before pyrolysis occurs. Project proponents are allow to use more than one sectoral scope methodology in their projects following VCS Program requirements on double accounting and establishing project boundaries. Please see *VCS Standard v4.1* Section 3.5.2 for additional guidance on

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					applying more than one methodology at a project site.
9		PDF	Responses are directly in the document	Stefan responded to numerous comments in the PDF. These need to be reviewed	Comments have been addressed in the PDF document
10 (1)	Definitions	The most important point for me would be how the energy efficiency of the process is defined. In the text the high technology process is defined as "(b) ability to utilize at least 70% of the waste heat during biochar production". Whereas in the table it is defined as "use of more than 70% of the energy output of pyrolysis". These definitions need to be harmonised and the definition should be clarified as 70% of the energy output of pyrolysis. This is because in industrial pyrolysis the energy fluxes including heat are defined in MWh. In this manner the wood (or other biomass) entering the process is expressed in MWh/t, after which the biochar, heat and electricity produced is converted to MWh and the overall energy efficiency of the process can be calculated. If only the heat was considered it would not be	Definition around energy and heat have been revised and harmonized in the methodology		

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		representative of an efficient process.			
10 (2)	Applicability Conditions	It is good to define between high and low technology pyrolysis. But it would also be useful to specify that biomass cannot be imported from within a certain perimeter. In order to avoid the import of non-sustainable biomass from Africa into Europe.	Sustainability criteria and GHG emission accounting boundaries from sourcing to application have been considered in the methodology development. Transport emissions are also included and shall be accounted when applicable		
10 (3)	General (energy production)	It is also possible to take into account the CO2 intensity of the electricity produced from biochar production. A full LCA can calculate the CO2 intensity of production and if this is less than the country mix then the biochar production process has also avoided potential CO2 emissions	CDM Tool 05 should be used for any grid connected electricity related emissions. The project proponent should also be aware of the *VCS Standard* regulation and requirements on the energy sector (see Table 1 in *VCS Standard v4.1*).		
10 (4)	Applicability Conditions	If default emissions values for low technology systems are based on Cornelissen et al., 2016 then the technologies should be differentiated by type (Traditional kiln, retort or flame curtain) as there is a very wide range of emissions values in this paper. Furthermore, traditional kilns represent the majority of production techniques in the developing world.	The methodology is technology agnostic. It provides guidelines on technology differentiation but does not differentiate between type, techniques, characteristics and others.		
10 (5)	Applicability Conditions	Finally from what I can see in the methodology there are no measures against the import of biochar from one continent to another.	Please see 10.2		
11		Tracked changes	Responses are directly in the document		

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12 (1)	Applicability Conditions	Regarding (b) ability to utilize at least 70% of the waste heat during biochar production. While this makes sense in a European sub-urban or urban context, it does not in the boreal forests of Northern Quebec. Energy is very cheap here (0.07 CAD per kWh) and clean in its production and use. In Quebec even heating in the winter is at 99% hydro-electric. There is also potential for almost infinite new renewable energies (with coming mobile wind and solar systems as MASWES 30 kWh) where we will be making biochar. We will be producing our biochar on-site, in particular to avoid moving huge quantities of dead logs from far away… There is no obvious use for energy from middle to large size kilns (yet mobile) in the middle of boreal forests. Hence this requirement appears as not being site adapted.	According to your description, your technology is not set up to capture waste heat and will therefore fall into the low technology category. The methodology explains the factors and options for calculating VCUs generated using low technology systems.		
12 (2)	Applicability Conditions	*« When processed timber is used as feedstock, all plastic, rubber, metals, reactive coating (such as paint, glues) must be removed from the feedstock for health and safety reasons (Hedley et al.,2020; EBC, 2012). »* This restriction would limit the biochar industry by up to 70%. It would also limit industrial societies managing contaminated waste properly. If used in asphalt, 'second grade biochar' would have a limited impact on the environment. Currently most contaminated wood waste end up being burned, slurry is even spread on some agriculture lands… Biochar using contaminated material for non-	The sustainability criteria has been revised; please see Section 4, Table 3.		

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		soils uses, is indeed a solution, not a problem, to the contamination of ecosystems. If used in concrete, this 'not so pure but still usable biochar', could become a substitute for marine sands, arguably the most destructive material of the construction industry—entire marine ecosystems are being destroyed for marine (gripping) sand. The need for a substitute to marine sands (biochar can be one) is also driven by a shortage of the product, and, its control by illegal and even criminal organisations.			
12 (3)	Applicability Conditions	*« Only biochar produced in high technology production facilities, as defined under the methodology, are eligible to be used in non-soil applications. »* We do not see the justification for such an important restriction? We believe asphalt might be the easiest market for our biochar that will be produced on-site using 100% clean wood with low-technology kilns. This restriction might be very consequential and detrimental for the nascent biochar industry. In fact an argument could even be made for (less problematic) non-soils applications of biochar produced with low technologies. Restricting uses might affect developments of lower-tech kilns to manage problematic waste in developing, cash-limited countries.	At high technology facilities, we can more appropriately account GHG emissions from production of biochar, whereas that is not possible in low tech facilities. Additionally, through high technology we wanted to ensure a minimum quality standard for biochar to be used in non-soil applications. Lastly, the methodolgy intends to incentivise the use of high technology production rather than low technology.		
13 (1)	Applicability Conditions	Could you provide clarification regarding the restriction of no mixing of feedstock? Is the "no mixing" set at the category level (e.g., agricultural waste, forestry and wood	Mixing refers to a specific feedstock; it's initial exclusion was due to the IPCC default values for organic carbon content depend on the initial feedstock. However, the mixing restriction has been revised		

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		processing, etc) or specific feedstock (e.g., harvest residues, tree pruning, etc.,.)?	and updated in the methodology providing clarity on situations where it may be allowed.		
13 (2)	Definitions	The methodology states a material change is 10% or greater shift in feedstock. Would we need to establish a new project if greater than 10% shift?	No, it would qualify as a new biochar type		
13 (3)	Quantification of GHG Emission Reductions and Removals	What would be considered an acceptable amount of chemical analysis testing to verify carbon content from the biochar? For example, sampling and testing every 10 tonnes?	The project proponent needs to test against the national or international guidelines such as IBI and EBC ~~guidelines~~. EBC guidelines, for example, ~~show~~ include the steps on how to do sampling for biochar analysis		
13 (4)	General (Project development)	What would be considered an acceptable amount of random audits to ensure smallholder farmers pyrolysis process? For example, our team makes site visits to record the farmers' production activities. Would we need to perform the verification for each farmer?	The~~is~~ guidelines for validation and verification of a project are covered by the *VCS Standard v4.1* and are out of the scope of methodology.		
13 (5)	Definitions	The methodology states a material change is considered when processing time changes by more than 10%. Does this apply to low technology solutions?	The definition has been revised.		
13 (6)	Applicability Conditions	The methodology is silent regarding the usage of biochar with animal feed. Would this be considered an accepted non-soil application?	The use of biochar as animal feed is now allowed. ~~Under VCS there is currently one methodology on animal feed that the project proponent can apply.~~ However, the project proponent needs to demonstrate the carbon permanence of the biochar in its end use application	Liz: I would recommend removing the reference to vm41 Stefan: I agree. The question is only about eligible biochar use. However, I do not see in the revised meth that animal feed has been added	In feed additive is not a removal activity, it is an emission reduction activity through reduced methane formation in the rumen of the livestock. Filteration products (e.g., water filter) may not represent long term use (100 years or more), hence now removed. Animal feed is not currently an eligible end use application since the carbon permanence cannot be proved

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13 (7)	Baseline Scenario	The smallholder farmers will be leveraging "low technology" to produce the biochar. Due to the CH4 emission expenditure of such technology, we will be considering the emission factors for the baseline scenario, predominantly combustion of waste biomass due to open field burning. The methodology states that in the absence of records to determine and prove the fate of waste biomass, we could leverage existing literature. What literature would be accepted as proof of evidence?	Literature can be scientific papers or reports which indicate such a requirement. ~~It can also include things such as goverment reports .~~ Further, as described in section 6 of the methodology, "examples of evidence include but are not limited to annual government records, records of a waste disposal facility, records of production facility among others. In the absence of records, the project proponent must utilize data from existing literature, existing survey data of similar industries in the same region, or conduct its own survey"	Correct this response as the alternative baseline scenario has been removed	In the revised methodology, the default baseline emission avoidance scenario for the project activity feedstock is zero (a conservative assumption). No avoidance emission are considered.
14 (1)	Definitions	Definition of biochar: syngas is generated in both pyrolysis and gasification.	Definition has been revised.		
14 (2)	Applicability Conditions	Eligible feedstocks and production: for the waste biomass to be eligible as feedstock for biochar production, the waste biomass would have been left to decay or combusted in the baseline scenario. However, there is no further description of the conditions for such combustion. If the waste biomass was combusted in open fields without energy recovery, then conversion to biochar and sequestration would clearly result in carbon removals. However, if the waste biomass was combusted to provide energy in the baseline scenario, diverting it to biochar may result in carbon leakage as other type of energy source may have to be used tocompensate for this diversion. Please provide more clarity on the conditions for combustion in the baseline.	The ~~D~~determination of the baseline has been revised and updated to reflect that the baseline scenario cannot include energy recovery.		

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14 (3)	Applicability Conditions	Non-soil applications are ineligible if there is a loss of more than 50% of the original biochar produced: what is the rationale for this? A biochar producer may decide to sell 60% of the biochar produced as a substitute for charcoal fuel and 40% as a concrete additive. What do you mean by loss?	The requirement refers to the end use application of the biochar, not to ~~the~~its total production and utilization in different sectors. For example, if biochar is used later to produce activated carbon, then over 50% of the original carbon material in the biochar itself will be reduced~~ in more than 50% of the original carbon material~~		
14 (4)	Project Boundary	*Table 4, CO2 conditionally to be included in a baseline scenario that describes the aerobic decomposition of feedstock*: does this mean that the CO2 emitted during the aerobic decomposition of the biomass waste is not considered to be renewable, i.e., absorbed by the next growth of biomass? Nonetheless, for feedstock production, the method states that: "waste biomass are (sic) also considered renewable per the CDM and project eligibility conditions". Please provide an example of the conditions for including CO2 as a GHG source in the aerobic decomposition of feedstock in the baseline.	Given the diversity of eligible feedstocks, it is not practical to provide baseline emissions factors for all types of waste biomass (slash, manure, algae, agricultural residues) in all types of environments (temperate and tropical regions). Therefore, the biochar methodology has been set up as a framework which sets the baseline emissions at zero (a conservative assumption). However, the "conditional" term is used in Section 5, Table 4 to ~~provide~~ allow the project proponent to provide their own emissions factors local to their region so long as the data meets certain criteria.		
14 (5)	Quantification of GHG Emission Reductions and Removals	*Quantification of baseline and project emissions*: This methodology states that it "provides a complete, robust and credible approach to quantifying net GHG emissions reduction[s] and removals resulting from biochar management, including the waste biomass sourcing stage, production stage and application of biochar stage". While this methodology is a step forward in crediting biochar application, it is not complete as the potential emissions avoidance due to fossil fuel displacement with the co-products	Please see 8.1 response. The project activity is the application of biochar. Co-products are important but are out of the methodology scope~~GHG boundaries~~. Fossil fuels displacement falls under the energy sector and is not considered within the methodology.		

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		(heat, electricity, bio-oil, syngas and wood vinegar) is excluded.			
14 (6)	Quantification of GHG Emission Reductions and Removals	*Accounting for the emissions from the thermochemical processes, while excluding the potential GHG emissions avoidance due to the displacement of fossil fuels with the co-products from biochar production*: the entire GHG emissions from the pyrolysis and gasification technologies are attributed unproportionally to only the biochar production process, when in ordinary reality, the benefits provided by the co-products are the game changers. Therefore, this method may have to be stacked up with other methods that consider the potential use of the co-products to displace fossil fuels.	Please see 8.1 and 14.5 responses		
14 (7)	Quantification of GHG Emission Reductions and Removals	*GHG baseline emissions at the sourcing stage:* "The baseline scenario is the situation where, in the absence of the project activity, waste biomass would have been left to decay of would have been combusted until the end of the crediting period within the project boundary". It would be very difficult to predict, let alone demonstrate, the fate of the biomass waste during the whole crediting period.	Section 8.2 has been revised. The baseline scenario considers the fate of biomass in the year that biochar is made.		
14 (8)	Quantification of GHG Emission Reductions and Removals	*Estimate [the] fixed carbon content of biochar*: This value is derived from the dry mass of biochar, carbon content and the decay rate of biochar. It is appropriate to specify	Adding the specifier "dry weight" contributes to the accuracy of the measurement. Consequently this addition has been accepted.		

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		that the mass of biochar must be considered in dry weight.			
14 (9)	Quantification of GHG Emission Reductions and Removals	*FCp*: the "organic carbon content of biochar for each production type per tonne of biochar". FCp is a fraction (%) regardless of the units of the biochar.	The unit has been specified in the respective formulas		
14 (10)	Quantification of GHG Emission Reductions and Removals	*Emissions associated with the thermochemical process (pyrolysis)*: throughout most of the document, there is an emphasis only on pyrolysis, whereas the technology scope mentions that "the methodology is applicable when biochar is produced from waste biomass through pyrolysis, gasification, and biomass boilers …". Suggest being consistent and use a general description of the technology, such as eligible thermochemical processes instead of only pyrolysis.	Thermochemical process has been added. However, for the purpose of the methodology, pyrolysis can be read as an overarching term. Please refer to the footnote.		
14 (11)	Quantification of GHG Emission Reductions and Removals	*Equation 8*: The definition of PRde states that the Fperm default value of 0.56 shall be used. Do you mean PRde instead of Fperm?	The unit description has been updated referencing the correct IPPCC table and formula reference. Further, more details have been added to the footnote.		
14 (12)	Quantification of GHG Emission Reductions and Removals	*Table 5, biosolids:* It seems that biosolids are not an eligible feedstock because of the relatively low carbon content of the respective biochar. If that is the case, it would be clearer to remove biosolids from this table and to clearly provide a rationale for their exclusion in the respective section of eligible feedstocks. Otherwise, it can be confusing.	Table 5 has been revised and modified to provide clarity to the project proponent		

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14 (13)	Leakage	*Leakage emissions due to transport of biomass and biochar*: If there is no transport, then there is no production, no application, no demand, no market. Transport is not leakage; it is an important activity within the project boundaries and a key factor in biochar supply chains.	Project boundaries include sourcing. production and application stages. Hence, most appropriate way of including transport was through leakage.	Agreed, though per the commenter leakage is not the most appropriate term. Is there a better way to frame this?	Transportation is not an essential/mandatory component. There could be scenearios (though rare) where waste biomass is coming from the AGR fields, the farmer (or the farmer cooperative in the village) has their own pyrolysis facility and the biochar used within the geographic location of the project, i.e., same field(s). As project boundaries include sourcing, production and application stages, transportation itself is not a part of any of these stages, rather it may form a link between the two or more stages. Therefore, leakage is the most appropriate concept to include emissions from transportation.
14 (14)	Quantification of GHG Emission Reductions and Removals	*Moisture content of the biomass waste and the biochar:* Both the biomass waste and the biochar will have a certain amount of moisture, which is important to consider as the calculations are based on the dry mass of both the feedstocks and the biochar. However, there is no guidance to measure, monitor and verify the moisture content of these materials.	See 14(8). A~~dditional information~~ Reference ~~in the methodology~~ to ASTM D1762-84 Standard Test Method for Chemical Analysis of Wood Charcoal (found in Section 4.1 of the IBI Standard) has been added		
14 (15)	Monitoring	*Box 1*: "To prevent double accounting of carbon benefits, the final location of the site where the carbon sink is created should be registered, where possible." How does that prevent double counting? In fact, in many cases, biochar works best when it is applied frequently to	Methodology does not limit the number of applications at a location, rather this statement refers to the carbon sink / pool created. In projects that generate carbon credits from the Soil Organic Carbon pool, the project proponent cannot account for that pool if biochar was applied within the same project boundary. Under the *VCS Standard v4.1*, project		

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		the same soils rather than through one-off applications.	proponents are allowed to use different methdologies in their project design, however, the project and GHG boundaries must be clearly defined		
14 (16)	Appendix 1	*Appendix 1*: the appendix says that biochar trials are likely "to prove the material's effectiveness compared to existing competing products (e.g., as a beneficial soil amendment compared to compost and other well established soil amendments)". This comparison is misleading as, in many cases, biochar works best when mixed with compost, manure or other fertilisers, so these soil amendments work in synergy rather than in competition. For example, the biochars with the highest carbon removal potential (wood-derived biochars) lack nutrients for soil application and are therefore recommended to be mixed with nutrients.	Paragraphs have been re-written to avoid misinterpretation by the reader and highlight biochar benefits.		
15 (1)	Applicabilit y Conditions	On page 7, when defining "Waste biomass" we suggest adding municipal wastewater treatment as an example of a source for Waste biomass. We believe that wastewater sludge will become an increasingly important feedstock for producing biochar, and that this justifies the addition of wastewater sludge/biosolids as an example. The text is suggested to be updated as follows (1st sentence only): "Biomass, by-products, residues and waste streams from agriculture, forestry, municipalities and related industries. "	Definition of waste biomass has been amended. For a list of eligible feedstock please refer to Section 4, Table 3		

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15 (2)	Applicability Conditions	Table 3, page 10 lists the eligible feedstocks for biochar production. In order to be characterized as a Recycling Economy feedstock, the sustainability criteria column refers to CDM EB 23 Report Annex 18, which states that: "Biomass is “renewable” if one of the following five conditions applies: 1.. 2.. 3.. 4.. 5. The biomass is the non-fossil fraction of an industrial or municipal waste." Since sewage sludge can be characterized as a non-fossil fraction of municipal waste, we conclude that sewage sludge can be considered a Recycling Economy feedstock. To avoid and mitigate any confusion around this, we suggest that wastewater sludge is mentioned in the column of examples changing the text to: “Urban green cuttings, non-hazardous municipal green waste, waste paper, wastewater sludge”.	Table 3 has been revised. The addition of wastewaster sludge has been considered and approved		
15 (3)	Quantification of GHG emissions reductions and removals	In section 8.2.21 Step 1 the CCy,t is calculated using the factor PRde. This is conservatively set to a value of 0.74. referring to literature from 2013 and 2015 and European Biochar Certificate methodology. IPCC has in 2019 published information on the same topic. Please see: “Appendix4: Method for Estimating the Change in Mineral Soil Organic Carbon Stocks from Biochar Amendments: Basis for Future Methodological Development” which can be found on *19R_V4_Ch02_Ap4_Biochar.pdf (iges.or.jp). The factor Fpermp used by IPCC has the identical definition as the	The option to determine the appropriate degradation factor has been added based on the new parameter Tprod. The utilized values are indeed derived from the IPPC source as approved by the commentator. To remain conservative, the uncertainty has been deducted from the factor, which was indicated to yield more transparency.		

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		PRde used by you. It is evident from Table 4AP.2 in the IPCC method description, that the pyrolysis temperature has a strong impact on PRde (see the data in the table below). We would like this to be included in the VCS standard and that the PRde is given a value of 0.89 for biochars produced at temperatures > 600 °C, i.e. that the values found by the comprehensive IPCC review are used for the VCS methodology and that 3 intervals based on the pyrolysis temperature are included. Further it could be included that pyrolysis time should be > 5 minutes in order to use a PRde above the default value of 0.74 for high tech. processing.			
16	Applicability Conditions	Restoration Bioproducts LLC is a nascent biochar producer in the United States. We hope to produce biochar, and utilize the pyrolysis gas to produce power and/or heat for industrial applications. Our first project will use waste wood fibers. Our subsequent projects may utilize purpose-grown biomass feedstocks particularly switchgrass (Panix virgatum). Switchgrass has been studied extensively as a crop to reduce runoff, increase carbon sequestration, and restore soils. Our experience with it indicates that we can grow switchgrass and achieve all those goals concurrently with a biochar production project. Carbon finance is an important component of the financial model. Sustainability is readily achieved and documented, and we feel strongly that we can	Please see comment 6.2		

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		show that the food production competition issue isn't applicable. The acres where we grow switchgrass are either abandoned, fallow, or otherwise underutilized. My recommendation is to allow project developers to document that acres used to grow switchgrass are not restricting food production in the country or region where the feedstock is grown thereby eliminating this concern. Furthermore, the sustainability of purpose-grown feedstock should be addressed in terms of carbon emissions to indicate an indisputably conservative estimate of a de minimis (or more likely sequestering) carbon pool impact. This analysis should address land use change 10 years prior to feedstock production.			
17 (1)	Quantification of GHG Emission Reductions and Removals	The degradation rate for 100 years is taken from EBC. There is an ongoing discussion as to whether this is the right value. CarbonFuture has a more precise approach. EBC is actually taking a middle value, that does not take into account, that in the first years more C will be degraded. And it does not take into account, that on top oft hat if less C is available fro degradation, the rate will go down. I recommend you have a look at the arguments and calculations that CarbonFuture hass et up.	The degradation process of biochar as utilized in the CarbonFuture model has been discussed between the developers ~~consortium~~ and CarbonFuture in the past. While we generally agree with this understanding, the consortium suggests ~~to utilize~~ the use of internationally approved values from the IPCC (2019) report, which is closely aligned with the requirements from VCS as well.		
17 (2)	Baseline Scenario	You state that possible avoided emissions from decaying/bruning biomass might be incorporated if certain documents can be provided. Does it refer to the Delta existing between possible emissions like	Baseline avoided emission scenario has been set ~~up~~ as zero following a conservative approach and in order to avoid double accouting.		

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		Methan and the CO2 equivilant accounted for in the carbon sink? Based on the different factors than you muiltilply methan (X298) and Co2 with when you include it in the GHG accounting? Because from my understanding the C of the biomass (in Co2 equivilant) when burnt can not be included in the methodolgy, as it is already accounted for in the biochar. This will be double counting.			
17 (3)	Project Boundary	What about avoided emissions like nitrous oxide from N-fertilization if biochar is present in the soil?	The methodology accounts ~~from~~for sourcing until final application of biochar either in soil or non-soil application. The project boundary includes all emissions related to the sourcing, prodution and application. N-fertilization is not part of the current project boundary emissions		
18 (1)	Applicability Conditions	First, we are concerned that the maximum residue removal rates may not be conservative. Two citations, Battaglia et al. 2020 and Andrew 2006 are referenced in the protocol to support the 70% residue removal threshold. Battaglia et al. 2020 references Blanco-Canqui and Lal 2009 in stating that removal rates of greater than 75% reduced SOC between 20% and 30% (we presume this is where the 70% threshold came from). But, in reading Blanco-Canqui and Lal 2009, there is a clear linear decline with SOC with increased removal rates until 75% removal, after which 75% removal causes the same declines in SOC as 100% removal. As such, the paper concludes that only 25% of crop residues should be removed. Ruis and Blanco-Canqui 2017 likewise found that >50% residue removal	Papers have been reviewed and the percentage removal has been revised.	Specify that Table 3 has been revised and the value is now 50%	Papers have been reviewed and the percentage removal has been revised. Based on available information, the Table 3 has been revised and currently feedstock removal is limited to no more than 50% of total residues

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		reduces SOC stocks by 0.87 Mg ha-1 yr-1 whereas <50% residue removal reduces C stocks by 0.31 Mg ha-1 yr-1. In any event, both scenarios constitute a significant source of SOC leakage that could occur as a result of project activities. Verra should either substantiate the chosen 70% residue removal threshold within the protocol or lower the threshold to be indisputably conservative. Alternatively, the protocol could allow for removal rates based on site specific erodibility.			
18 (2)	General (Double counting)	Our second concern is that the protocol does not provide adequate safeguards against double counting, and this is especially concerning given that the protocol allows virtually any end user to submit a project, presumably for the same biochar. Double counting is addressed twice in the protocol: 1) when project boundaries overlap with other methodologies, proponents need to demonstrate no double-counting, and 2) if a biochar facility sells energy back to the grid as part of a separate renewable energy program, the biochar facility cannot claim these avoided emissions while using the Verra protocol. However, the protocol does not describe how double counting will be avoided within this biochar protocol, or across competing protocols. For instance, as the protocol is written, a biochar producer and a farmer could both submit projects using the same biochar. An even more likely scenario is that a biochar producer submits a project, and a secondary	Safeguards for double accounting are found within the *VCS Program* guidelines and requirements, which any project implementing this methodology must comply with. The methodology accounts for GHG emissions from the biochar value chain, from sourcing until application. The methodology project activity is the final application of biochar that can be secured and registered as a carbon sink. Further, before a project issues carbon credits, they undergo validation/ verification in order to avoid claiming multiple GHG benefits. Emission reductions claimed for energy sold is excluded from this methodology. Additionally, VCS omits grid connected RE projects as per Section 2.1 of *VCS Standard 4.1*		

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		manufacturer (e.g. water filter manufacturers) also submits a project, either under Verra or under a competing biochar carbon market.			
18 (3)	Quantification of GHG Emission Reductions and Removals	Last, we found several places where clarity should be improved with regards to the permanence calculation for biochar. Project managers will presumably receive %C, %N, and %H when they contract the CHN analysis, but the text isn't clear on whether projects actually need to report the H:Corg to Verra. Likewise, it is not clear what projects should do if the H:Corg is above 0.4 for a high tech system. Should those projects use the default low-tech system calculation of 56%? Third, it is not clear from the protocol how the value of 74% was determined for high-tech systems and why it is conservative; the literature cited in the protocol, Budai et al. 2013, states that a lower permanence value of 70% should be inferred for an H:Corg below 0.4.	~~H:Corg shall be present to the auditor since this is a parameter for equation 4.~~ The value for H:Corg has been modified to 0.7. Also, the 74% has been modified and currently is based on the temperature process following a conservative approach		
18 (4)	Applicability Conditions	Finally, we feel that the applicability conditions for allowing additives (10%) needs further elaboration. What is the rationale for allowing additives, and how does this support the end goal of net climate mitigation? The protocol should also explicitly state whether additives	A segment of biochar producers add certain additives to their products to adjust pH, increase functionality, among other reasons. The rationale for including it in the methodology is to be inclusive and reflective of how biochar is sometimes made in the real world. Further, ~~by~~ setting a 10% limit ensures		

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		could bias the carbon concentration calculation, and how this bias is avoided.	that if an additive like rock powder (which the scientific literature has shown is beneficial in soil) is used it will have a de minimus impact on the overall benefit calculations.		
19		Tracked changes	The comments have been addressed directly in the document.		
20 (1)	Applicability Conditions	I have done research on biochar production in cookstoves in Kenya. I see that you also have several cookstove projects. So I think it should be possible for you to adapt the biochar method to not only cover biochar made from waste biomass, but also biochar produced from wood in cookstoves. Projects that meet cookstove standards + produce biochar and use it in soil, should be able to get VCUs also for the biochar part of the project. Some references: https://link.springer.com/article/10.1007/s11027-020-09920-7 ; https://www.mdpi.com/1996-1073/12/22/4285	The methodology is agnostic regarding technology. The methodology provides a framework for GHG accouting independent of the type of technology used.		
21 (1)	Applicability Conditions	Eligible feedstocks: Eni understands that the list of eligible feedstocks included in the proposed methodology is non-exhaustive and that any biomass residue meeting the feedstock requirements included in the methodology are eligible for biochar production. However, Eni suggests expanding the list of eligible feedstocks already mentioned in the VCS methodology for biochar utilization (Table 3). To do this, the methodology should be aligned with the most advanced regulations of the sector, such as Annex IX to “Directive (EU) 2018/2001 of the European Parliament and of the European	Section 4, Table 3 has been revised and updated.		

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		Council of 11 December 2018 on the promotion of the use of energy from renewable sources" (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN) and the implementing rules of the "European Union initiative for Sustainable biofuels, bioliquids and biomass fuels – voluntary schemes" (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12723-Sustainable-biofuels-bioliquids-and-biomass-fuels-voluntary-schemes-implementing-rules-_en). In particular, Annex 4 of the latter sets out the minimum requirements in the method for certifying waste and residues, listing them in the following categories: food-feed processing residues and waste; agricultural/forestry residues and waste; landscape care biomass; animal residues and waste; wastewater and derivatives; fats, oil and freases; others.			
21 (2)	Baseline Scenario	Baseline scenario: Concerning point 3) of Verra's request for input about baseline emissions, Eni considers appropriate to sets baseline emissions to zero as conservative assumption. However, the methodology should keep in consideration that in many projects and geographical areas the advantage in GHG emissions reduction is primarily associated to the avoided emissions of the gases released from the decay or combustion of the feedstock that otherwise results in open-air landfill also contributing to local air pollution (e.g. sugar can residues decay in	Please see comment 17.2		

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		African countries). Thus, Eni welcomes the opportunity for project proponents to assess project specific avoided emissions baseline.			
21 (3)	Applicability Conditions	Activated carbons and other non-soil applications: Eni notes some inconsistencies in what is written in the methodology: - at page 7 of the methodology (non-soil applications definition) it is stated that some activated carbons are ineligible in non-soil applications. It is not clear if the ineligibility is referred to the type of activated carbon (i.e. its physical characteristics) or to its application. Moreover, it is stated that biochar is not eligible in other non-soil applications (other than the ones mentioned) if the fossil fuel inputs are excessive; - at page 11 of the methodology is generally stated that biochar must not be processed into activated carbon. It is required to clarify the following: is the ineligibility referred to some activated carbons or to all of them? In the first case, which are the discriminating factors? For non-soil application in general, when is an application considered fossil fuel intensive or when is the fossil fuel input considered excessive?	The wording will be adjusted. Activated carbon is ineligible because (in our understanding of the production process) more than 50% of the original biochar material is consumed during production. For example, if you start with 100 units of biochar, by the time you expose it to steam or sulfuric acid to ~~make~~convert it into activated carbon, you may only have 5 units of final product. The second reason is that the fossil fuel inputs necessary to manufacture/engineer biochar into products like activated carbon are significant (hence counteracting climate benefits). By comparison, if you have biochar and you are making a filtration product you may only need to sift the material to make sure it is of uniform size, and the biochar producer can use the fines in a compost product. In the later scenario, the fossil fuel inputs are not excessive and the majority of the original product is utilized.	If possible, it would be helpful to cite literature to support this response	Researchers that have made activated carbon in the laboratory indicate that the activation process is done chemically (e.g. with potassium hydroxide, phosphoric acid, CO2, Nitrogen) or physically using steam. Januszewicz et al. 2020 describes both processes in detail. Activation of the material typically occurs at high temperatures (above 700 degrees Celsius, which is high for a typical pyrolysis reactor designed for biochar production only). A 2018 study by Contescu et al showed that activation of biochar (using CO2 at 800 degrees Celsius) yielded 50% to 72% based on the initial char weight. In other words, if you start with 100 kilograms of dry biomass and the biochar machine has a 25% yield there will be 25 kilograms of biochar product before activation. If the activation process yield is 50%, then out of 25 kilograms of biochar only 12.5 kilograms remains as activated carbon. In our view, given both the fossil fuel inputs to convert biochar to activated carbon

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					and the mass-loss associated with is a basis to exclude it in the methodology. Citations: Januszewicz, K., Kazimierski, P., Klein, M., and Karda, D. 2020. Activated Carbon Produced by Pyrolysis of Waste Wood and Straw for Potential Wastewater Adsorption. Contescu, C., Adhikari, S., Gallego, N., and Evans, N. 2018. Activated Carbons Derived from High-Temperature Pyrolysis of Lignocellulosic Biomass. Journal of Carbon Research.
22 (1)	Applicability Conditions	Section 4, "Eligible feedstocks and production" • NetZero demands that all feedstocks be collected at a maximum range of 200 km from the biochar production facility, in order to minimise transport emissions and to ensure sufficient knowledge of the feedstock collection environment • For wood-based feedstock specifically, NetZero makes two observations. First, in too many places around the world, wood is linked to deforestation, and it can be very difficult to differentiate between sustainable wood and deforestation wood. Second, all forms of wood residues can already be valued in non-biochar uses that are also beneficial for our climate; this ranges from bioenergy (climate-neutral) to plywood (climate-positive, with long-term carbon sequestration potential). Consequently, NetZero demands	The methodology ~~already~~ accounts for the transportation emissions. If the feedstock is more than 200 km from the production facility, then the project proponent must include the transport emissions in the net GHG accounting. The methodology contains sustainability criteria regarding wood based feedstocks. The methodology is intended to be globally applicable and such a specific certification would not be available worldwide. The project proponent shall present proof of the sourcing feedstock at validation and every verification event. The VVB shall assess if the proof is sufficient or more documentation is required in order to certify the project		

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		that the following criteria be added to this section: "Wood-based feedstocks shall be regarded as eligible for biochar production only when they meet the following cumulative criteria: (i) With the exception of waste sourced from precisely identified orchard renewal programmes, feedstock must come from wood certified as deforestation-free by high-quality, recognised standards (ii) No industry capable of processing such feedstock exists in a 200 km radius of the biochar facility that could use such feedstock for non-biochar sustainable uses" Not including requirement (i) would be de facto accepting to condone the laundering of deforestation wood. Not including requirement (ii) would be a displacement of biomass usage from existing usages to biochar usages.			
22 (2)	Applicability Conditions	Section 4, table 3, "Forestry and other wood processing" category • Include carbonised biomass needing to be removed after wildfires • Remove last hyphen, as it is redundant with the first hyphen for most cases, it is too vague, and it is mostly not true (barks and chips not meeting quality specifications can be used for plywood, wood pellets, etc., which have commercial value)	Table 3 ~~under Forestry and other wood processing category~~ will be modified to say "trees burned by wildfires". The fourth hyphen has been revised. The eligibility criteria for feedstocks are "biomass waste". If the material has commercial value (e.g., as a plywood or wood pellet product) it would not be a waste product and hence ineligible as a feedstock.		
22 (3)	Applicability Conditions	Section 4, table 3, "Aquaculture plants" category • Include invasive algae on beaches • Consequently, rename category as "Marine waste"	The list is a non-exhaustive list. However, to add clarity ~~about the category,~~ invasive species has been added to the text.		
22 (4)	Applicability Conditions	Section 4, "Eligible biochar end-use application criteria" • For bullet point #5, remove "and/or reliable documentation" as it is too	Section 4 has been updated to reflect the information needed for the decay rate of biochar		

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		vague and a non-scientific approach, differing from the rest of this high-standard methodology • Consequently, remove bullet point #6			
22 (5)	Project Boundary	Section 5, table 4 • For all occurrences of “Default baseline is zero […]”, replace with “Default emission avoidance baseline is zero […]” for clarity	The suggestion has been considered and revised in the methodology.		
22 (6)	Baseline Scenario	Section 6, §1 Replace “The default baseline emission scenario […]” with “The default baseline emission avoidance scenario […]” for clarity	The suggestion has been considered and revised in the methodology.		
22 (7)	Baseline Scenario	Section 6, step 2 Either remove “or conduct its own survey” or replace with “pay for a professional, independently conducted survey, pre-validated by Verra”, as there is no way to verify the results of the survey conducted by the project proponent	Please see comment 17.2. Baseline avoided emission has been set ~~out~~ as zero.		
22 (8)	Quantification of GHG Emission Reductions and Removals	Section 8.2.1, equation (1) • Replace “ERSS” with “ERSS,y” for consistency • Simplify “SUMy(BESS,y – PESS,y)” as “BESS,y – PESS,y”	The equation has been corrected		
22 (9)	Quantification of GHG Emission Reductions and Removals	Section 8.2.1, equation (2) Where equation parameter BESS,y is defined, simplify “Sum of the baseline emissions […]” as “Baseline emissions […]”	The equation has been corrected		
22 (10)	Quantification of GHG Emission Reductions and Removals	Section 8.2.2 • In §2 (starting by “In the project scenario”), the notion of carbon sequestration is missing although this paragraph is about GHG removals; only production-related emissions are mentioned. The paragraph should be written as such: “In the project scenario, GHG removals at the biochar production	As per the methodology, the sequestration/removal occurs once the biochar is applied to its end use. Hence, the production stage will not yield removals but a carbon balance. The explanatory text has been amended in accordance. The parameter description for CC has been amended The parameter description for 44/12		

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		stage refer to the difference between the carbon contained in the biochar produced and the GHG emissions from feedstock pre-treatment (when applicable) and from conversion of waste biomass into biochar." • Where equation (3) parameter CCy,t is defined, change "tCO2e" to "t" as the unit • Where equation (3) parameter 44 12 is defined, change "tCO2e" to "CO2e"	doesn't need to be amended, since it correctly refers to CO2eq.		
22 (11)	Quantification of GHG Emission Reductions and Removals	Section 8.2.2.1, step 1 Carbon decay rate should be differentiated based on pyrolysis temperature, as suggested by the IPCC (2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Annex 4, table 4AP.2), since higher pyrolysis temperature produces more stable carbon	Table has been revised. See 15(3)		
22 (12)	Quantification of GHG Emission Reductions and Removals	Section 8.2.2.1, step 2 Equation (5) is unclear: either "PEPS,y" should be "PEPS,y,t", or "(My,t / Mx,t)" should be removed together with the initial sum to only have: "PEPS,y = PED,y + PEP,y + PEC,y"	The comment is correct and values have been updated to reflect the changes.		
22 (13)	Quantification of GHG Emission Reductions and Removals	Section 8.2.2.2, step 1 Default values for organic carbon content have too wide confidence intervals; a conservative maximum threshold should be set to prevent overestimates (e.g., when a value is 0.13 ± 50%, a 0.5 safety margin factor could be used, so that the maximum value would become 0.13+25%)	The values are based on IPCC latest information on organic carbon content. However, the table has been updated to reflect the value that the project proponent shall use following a conservative approach		

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22 (14)	Quantification of GHG Emission Reductions and Removals	Section 8.2.3 • For equation (13), replace "EAS,P" by "EAS,P,y" for consistency • For emissions associated with processing of biochar, review syntax of "project proponents must quantify emissions related to grinding and other mechanical transformation of biochar energy related emissions", writing instead something like "project proponents must quantify emissions related to energy use from grinding and other mechanical transformation of biochar"	The comment is correct and the respective section has been updated.		
22 (15)	Quantification of GHG Emission Reductions and Removals	Section 8.3, equation (16) • Replace "LEbl" with "LEbl,y" for consistency • Where equation parameters are defined, parameters "FCp" and "PRde" are missing • Where equation parameters are defined, rearrange variables order to put PEPS,y at the very end for consistency	The comment is correct and the respective section has been updated.		
22 (16)	Quantification of GHG Emission Reductions and Removals	Section 8.3, § LEtap Add the word "from" in points i. and ii. for clarity: "i. Transport emissions from biochar facility…" and "ii. Transport emissions from processing facility…")	The comment is correct and the respective section has been updated.		
22 (17)	Quantification of GHG Emission Reductions and Removals	Section 8.4.1.1 Replace last paragraph of the section (starting with "In a scenario when […]") with the following text: "In case a GHG risk event (e.g., fire, erosion, etc.) arises, all the subsequent credits generated by the biochar project should be diverted to compensate for the GHG released during this risk event. Only when all GHG emissions from the risk event have been compensated should the	The paragraph has been updated to reflect the risk associated with the GHG emissions.		

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		credits be allowed to be commercialised again”			
22 (18)	Monitoring	Section 9.1, “Fe” table, “Value applied” row • Replace “CO4” by “CH4” • Change closing bracket position from “The Global Warming Potential (GWP100 for CH4 is 28)” to “The Global Warming Potential (GWP100) for CH4 is 28” • Add GWP100 for N2O, as N2O is also taken into account in emission calculations	The table and parameters have been revised.		
22 (19)	Appendix I	Appendix I, section A1 In the paragraph where terms are defined for the activity penetration formula, replace AP by APy for consistency	The text has been modified.		
23 (1)	General	The German Biochar Association (Fachverband Pflanzenkohle e.V.) greatly appreciates efforts to mainstream the use of biochar as a negative emission technology. The reviewed standard is an important step towards a global use of biochar as a carbon sink. We value the fact that the methodology is based on several international standards and other methodologies, which helps to create global awareness of these standards and methodologies and leads to mutual benefits. However, we would also like to point out critique of the proposed methodology, with the goal of making it more robust and applicable. Our main critique points are (a) the lack of a clear distinction	a) refer to 23(2) b) The reference to methane emissions is unclear - which might related to conversion of CH4 to CO2eq in the reporting		

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		between C-sinks and C-offsets and (b) reckoning of methane emissions.			
23 (2)	Quantification of GHG Emission Reductions and Removals	Main critique (a): unclear distinction between C-sinks and C-offsets A clear differentiation between carbon removals (negative emissions - NE, creation of C-sinks) and carbon offset (avoiding emissions) in the methodology is a prerequisite to establishing a C-sink economy. In chapter 8.5 (Net GHG Emission Reductions and Removals) a formula is presented that sums up all removals, reductions, emissions and leaks into one factor – this is a sharp contrast to the definition of NE as used by most stakeholders. Also, commonly, C-sinks are looked at as more valuable than C-offsets, which results in different pricing of certified C-sinks (100-1000 € t-1 COeq) and offset-certificates (25±x € t-1 COeq). Mixing both values does overinflate the actual removal by adding reductions. If a bad baseline scenario is chosen the reductions could outnumber the removals greatly. This does mislead the buyer of the removal-certificate. It also devalues the main purpose of your biochar-based C-sink certificate and it could even harm the reputation of VCS and other methodologies. We therefore urge you to establish a methodology that results in separate certificates for offsets and C-sinks. Reductions (offsets) must be counted as regular CDM-certificates, not as removal-certificates. These two should be clearly separated and also priced differently.	Verra's registry does not differentiate between emission avoidance/reduction with GHG removals. If a project wants only sinks, *i.e.,* removals only, the project can and should use conservative baseline scenario of not accounting emissions avoidance. In the future, if Verra differentiates between credit types on the Registry, a revision can be made to differentiate between emissions reduction and removals	This response should be updated since the methodology has been amended to exclude any avoided emissions from feedstocks in the baseline. The result is that in this proposed version all VCUs issued will effectively be removals and could theoretically be marketed as such	Verra's registry does not differentiate between emission avoidance/reduction with GHG removals. The methodology has been revised to exclude any avoided emissions from feedstocks in the baseline.The default baseline emission avoidance scenario for the project activity feedstock is zero (a conservative assumption). No avoidance emission are considered. The result is that in this proposed version all VCUs issued will effectively be removals and could theoretically be marketed as such.

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23 (3)	Quantification of GHG Emission Reductions and Removals	Pyrolysis technology and methane emissions: The criteria provided are not suited to unequivocally distinguish, high-tech pyrolysis units from low tech pyrolysis devices. Most importantly, these criteria do not allow to distinguish units with high and low emissions. In the end, it will be necessary to measure methane emissions of each individual technology, which will result in individual factors for high-tech units. For low tech pyrolysis a positive list could be used. Traditional kilns and any self-developed unproven technology should be ruled out due to potentially very high methane emissions. In chapter 8.2.2.1 point c) and also Step 2 under PEP,y; = 0 you should add that methane emissions must be analyzed and reckoned with in any case.	Please refer to comment 6.1		
23 (4)	Applicability Conditions	Low-tech pyrolysis technology and methane emissions: There is a broad scientific consensus that the GHG-emissions of the current and the next few decades will be the pivot point that determines whether we can stay within the 1.5 or 2 °C goal. Methane has a severe impact on global warming within the first 25 years after its release. Therefore, we think that you should reflect more on the methane emissions, as high methane emissions during pyrolysis can offset any carbon removal at least in the first decades after the pyrolysis. We think that you should encourage the use of high tech pyrolysis which have proven to achieve low methane emissions or low tech pyrolysis that	The applicability of the methodology for small scale units has been a key concern of the consulted stakeholders. Therefore the consortium has decided to allow both technologies while ensuring a conservative approach, that reflects the voiced concerns. Methane emissions are accounted for in low-technology production, and overall, the methodology is technology agnostic. The selected approach in the methodology includes a high degradation factor as well as a relatively inefficient C-conversion. Both options lead to a lowered attractiveness of these approaches. We therefore believe the methodology reflects the concerns presented in the comment.		

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		is known for relatively low methane emissions and reject low tech solutions that are known for high methane emissions or that have not yet proven how they perform in terms of methane emissions (precautionary principle).			
23 (5)	Applicability Conditions	Non-soil applications: We think that the average lifespan of the product must be taken into consideration for any non-soil application. Even many long-life products, have lifespans much shorter than 100 years (concrete unprotected from weather 60-80 years1, plastic stored indoors less than 40 years2). Short-lived C-sinks are valuable; however, the lifespan and the product's end-of-life need to be reflected in the certificate and its price.	The methodology indicates permanence of products as a required characteristic of the end uses. In alignment with the *VCS Standard*, we do not consider shortened permanence timeframes.		
23 (6)	Applicability Conditions	In Chapter 4 under "Eligible feedstocks and production" you state: One of the following must be established for the waste biomass to be eligible as feedstock for biochar production: o waste biomass utilized as feedstock would have been combusted. It should be clarified that you mean combustion without using the energy of the combustion. Removing a source of energy in order to turn it into biochar, could lead to indirect land use change because additional energy sources must be found, if the biochar production does not create usable energy itself.	Please see 14.2. In addition, "without using the energy of combustion" cannot be added because eligible production types in the methodology include biomass energy plants that produce High Carbon Fly Ash (HCFA). We set a limit on the amount of biomass that can be diverted from biomass energy production to biochar at 5% of the annual biomass supply. As such, we intend to keep the Chapter 4 wording as "combustion" or "decay".		
23 (7)	Applicability Conditions	Also in Chapter 4 you state that "Biochar must not be used for energy purposes.". We would recommend to	The comment has been considered and the respected section has been updated.		

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		amend this by a statement like this: "Biochar must not be used in applications in which substantial amounts of the biochar are oxidized, e.g. burned or used as a reduction agent in steel production" Many pyrolysis practitioners, who contact our association, are unaware that using biochar (or coke) to reduce iron ore will also release all contained carbon as CO2, presumably because "use biochar in steel" sounds like a legitimate long term application.			
23 (8)	Applicability Conditions	Also in Chapter 4 you state: When biochar is applied into soils it must comply with biochar material standards to avoid the risk of transferring unwanted heavy metals and organic contaminants to soil. Project proponents must meet the IBI "Standardized Product Definition and Product Testing Guidelines for Biochar That is Used in Soil" and/or EBC "Guidelines for a sustainable production of biochar" , or national regulations for avoiding soil contaminations. We recommend to not write "and/or" but only "or", because this could imply that several standards must be met at the same time. And for "biochar, or" we recommend to write "and", since many national regulations will not be fit to judge biochar yet, and both national standards and biochar-standards must be met. Furthermore, it should be defined, how the proponents have to prove the conformity to these regulations. EBC is an audited certification. IBI on the other hand does not provide certification, thus it needs to be defined how conformity	The project proponent needs to prove to the project auditor that the biochar complies with regulations on end use. Also, IBI does issue material standard certifications for biochar. It is on the project proponent to provide the documentation required for the certification.	To the commenter's second point re "or national regulations" do we think that these regulations would provide sufficient safeguards where PPs decide to choose that route over IBI/EBC?	The project proponent needs to prove to the project auditor that the biochar complies with regulations on end use. Also, IBI does issue material standard certifications for biochar. It is on the project proponent to provide the documentation required for the certification. Further, the section "or national regulations" has been amended to include only "and" national regulations as suggested in the comment in order to provide sufficient safeguards and control GHG emission in the biochar production

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		with IBI definitions can be proved externally.			
23 (9)	Project Boundary	In Chapter 5, Table 4 you state: “Expected to be de minimis if less than 200 kilometers” We recommend to always calculate transportation with a proxy value from a LCA database, as distance is very easy to determine. Also, transportation emissions will probably be higher in areas with poor road infrastructure and would be considerably lower for rail or ship. It is unclear if 200 km means road length or beeline. You should always aim at minimizing transport distances.	The applicability conditions state that biochar can be only transported through vehicles; there is no approved approach to calculate emissions from rail and ships. Also, the methodology discourages the long distance transportation of feedstock and biochar. The limit of 200km is based on CDM Tool 16, which includes an option for conservative default values.	Applicability conditions in the revised draft refer to rail, ships, under 200km distance. Please revise.	The limit of 200km is based on CDM Tool 16, which includes an option for conservative default values. The waste biomass utilized as feedstock should not have been imported from other countries. Further, the waste biomass used as feedstock to produce biochar and produced biochar to be utilized in soil and/or non-soil applications may be transported via different media including vehicles, ships, boats, etc., only if the distance is within 200 km. Currently, there is no approved approach to calculate emissions from rail and ships. In addition, waste biomass can only be transported for more than 200 km through vehicles (road transportation) as defined under the CDM Tool 12: Project and leakage emissions from road transportation of freight. Also, the methodology discourages the long distance transportation of feedstock and biochar.
23 (10)	Quantification of GHG Emissions Reductions and Removals	Table 5: Values for Organic Carbon content in biochar. Although these values obviously have a high error margin, we think that a clear instruction should be given, which exact proxy values one should use for estimates.	Table 5 has been updated accordingly.		
23 (11)	Quantification of GHG Emissions Reductions and Removals	It is unclear to us, how biochar can be lost during droughts. Also, while biochar can be washed away during floods, the carbon removal will still	Drought has been reviewed and removed. If biochar is lost due to runoff, then it is outside the project boundary and there is no appropriate and adequate	Yes, but per this commenter's point and also Lehmann above, run-off/erosion	Drought has been reviewed and removed. In case of wind and water erosion, GHG reversal is represented by loss

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		remain, as biochar will end up in sediments of a river, lake or ocean where it remains at least equally stable as in soil.	procedure to account for that. Hence, run off is included in the risk.	can happen but will not lead to reversal, rather higher likelihood of sequestration if buried in sediment, for example	of biochar to outside of the project boundary and can not be appropriately and adequately monitored and reported. Though this may not directly represent the reversal of sequestered carbon to the atmosphere. **As the fate of biochar outside the project can not be determined and confirmed, applying the conservative approach a loss of biochar due to soil and wind erosion is considered as reversal.**
23 (12)	Definitions	Treatment of waste materials falls under laws and regulations on waste (at least in the EU), which would be a burden for biochar producers. Most of the materials you are referring to, are residues, not wastes. Also, this wording could cause considerable public communication issues on biochar-use in soil.	The comments has been reviewed but waste biomass is an internationally accepted terminology. We will maintain the term.		
23 (13)	Quantification of GHG Emissions Reductions and Removals	In chapter 8.2.2 you state that "In the project scenario, GHG removals at the biochar production stage refer to GHG emissions from feedstock pre-treatment (when applicable) and from conversion of waste biomass into biochar." We think that a clear distinction should be made between a potential removal (at the factory gate of the pyrolysis) and an actual removal (when the biochar is used and thus cannot be oxidized any more neither on purpose nor accidentally).	The comment has been reviewed and section 8.2.2 has been rephrased. The project activity is the final use of biochar either in soil or non-soil applications, and thus, the project proponent cannot claim credits if they only produce biochar. The project proponent needs to prove an application.		
23 (14)	Quantification of GHG Emissions Reductions and Removals	You state that "Eap corresponds to emissions during the application of biochar to the soil. GHG emissions resulting due to fossil fuel combustion and	The comment has been reviewed and the sentence has been rephrased.		

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		fertilizer application are considered negligible. Thus, Eap is zero" Do you mean, when biochar is applied in combination with fertilizer or a fertilizer product that contains biochar? Biochar itself is not a fertilizer.			
23 (15)	Quantification of GHG Emissions Reductions and Removals	You state that 44/12 is a "Fraction to convert fixed carbon to tCO_2e". We recommend to use the more precise wording "coefficient" rather than fraction.	Fraction has been changed to coefficient		
23 (16)	Applicability Conditions	In the beginning of Chapter 4 you state that the final application must be permanent. Permanent is a rather unclear term, since biochar may not be permanent when looked at on a geological or even astronomical scale. Also, the term permanent is often used for applications that are not really permanent, even on a short timescale. We therefore would recommend to set a certain timespan as your definition of permanence.	see 23 (5)		
24 (1)	General	I support the general approach taken to quantification of GHG benefits from biochar systems, inducing the scope, sources and sinks covered, and calculation of benefits. I appreciate the breadth with respect to feedstocks, production technologies and applications, and that there are options for proponent to obtain required data where default data are not included.	We appreciate the feedback.		
24 (2)	Baseline Scenario	I support providing the option to include avoided baseline emissions. I would like to see this extended to a broader range of biomass fates in the baseline, including field spreading of raw or composted manure.	Fate of biomass has been maintained; the methodology developers will not extend to a broader range at this time.	Does this need to be updated since baseline emissions are now conservatively excluded?	In the revised methodology, the default baseline emission avoidance scenario for the project activity feedstock is zero (a conservative assumption). No avoidance emission are considered,

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					therefore, there is no fate of biomass in the baseline
24 (3)	Applicability Conditions	It is inappropriate that mixing of feedstocks is prohibited; often a mix of feedstocks (such as manure and straw) is beneficial for producing high quality biochar, giving greatest benefits as a soil amendment. Does this requirement preclude the use of poultry litter (manure on bedding)? That would be particularly unfortunate as this feedstock makes excellent biochar.	The individual biochar soil-persistence values in the methodology (PRde) are based on IPCC data backed by meta-data at a global scale. However, the mixing has been revised and updated in the methodology to provide clarity on which cases are allowed.		
24 (4)	Applicability Conditions	Please include biosolids (sewage sludge) in Table 3, under “Recycling economy”. Delete or modify “Feedstocks must not contain heavy metals”. The issue of heavy metal contamination should be managed through requirement for compliance with relevant standards and guidelines, and applied to all feedstocks. Here, if you want to alert users that these feedstocks you could say something like “Risk of heavy metal contamination: Confirm that relevant thresholds for heavy metals are not exceeded”.	The comment has been reviewed and the table has been updated.		
24 (5)	Applicability Conditions	I encourage the inclusion of purpose-grown biomass as an eligible feedstock, to facilitate scaling up of biochar production.	Please see 6.2. The first version of the methodology will not include purpose-grown biomass as eligible feedstock due to sectoral scope, additional GHG emission quantification with growing biomass feedstock, baseline scenario, monitoring		
24 (6)	Quantification of GHG Emissions Reductions and Removals	8.2.2.2 c): Unclear. The statement of the criterion is incomplete	The comment is not clear. However, section 8.2.2.2 has been revised.		

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24 (7)	Quantification of GHG Emissions Reductions and Removals	Re Estimation of fixed carbon content (CC) of biochar for high technology facilities. I can't find what decay rate is proposed for biochar with H:Corg>0.4. Are you proposing the same classes as Budai et al, 2013? Are the source details provided for the cited references?	The value has been corrected. Now it reads H:Corg < 0.7.		
24 (8)	General (Priming)	Priming should be permitted as an optional GHG benefit that can be included when justified (ie applied to appropriate soil type). Priming is now well-proven (Joseph et al 2021 https://doi.org/10.1111/gcbb.12885 ; Schmidt et al, 2021 https://doi.org/10.1111/gcbb.12889)	There is no clear effect of priming based on the latest publication of Woolf, Lehman, et at (2021). Further, the scope on priming is related to the SOC carbon pool, and the project activity for this methodology is the application of biochar in soil and non-soil end uses. Therefore, the GHG emissions associated with priming are outside the boundaries of this methodology.		
24 (9)	General (International standards)	Please note that Australia New Zealand Biochar Industry Group is finalising a Code of Practice that provides guidance on sustainable, safe production and use of biochar as a soil amendment, including limits for a range of inorganic elements and organic compounds. This could also be referenced. https://anzbig.org/wp-content/uploads/2020/07/ANZBI-Biochar-Code-of-Practice_2June2020_Draft.pdf	At this time, the ANZ Code of Practice has still not been finalized, but it may be included in future versions of the methodology.		
25 (1)	Applicability Conditions	"*When biochar is applied into soils it must comply with biochar material standards to avoid the risk of transferring unwanted heavy metals and organic contaminants to soil. Project proponents must meet the IBI "Standardized Product Definition and Product Testing Guidelines for Biochar That is Used in Soil"5 and/or EBC "Guidelines for a*	Wording has been corrected. Please also see comment response 23 (8)		

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		sustainable production of biochar"6, or national regulations for avoiding soil contaminations." (p. 11) Leaning only on national regulations poses a risk and a loophole for watering down the "do no harm" principle. This should only apply in case of even stricter national regulations that are already in place. In several countries there might be an absence of sufficient regulation (e.g., failed states). Leaning on national regulations in such cases, poses a severe risk of allowing the use of contaminated material.			
25 (2)	Applicability Conditions	*"To establish the decay rate of biochar in a given non-soil application, in the absence of supporting documentation, the project must apply the default decay rate of biochar in soils following a conservative approach."* (p.11) The term "Conservative approach" should be defined. Applying a soil-based decay rate in non-soil applications runs the risk of significantly over -or underestimating the decay rate and no reliable quantifications can be performed in this case. We advise not to include applications without a proper scientific foundation.	Following a conservative approach means to use conservative assumptions, values and procedures to ensure that net GHG emission reductions or removals are not overestimated. The use of the soil decay rate for non-soil applications is because non-soil applications present a lower decay rate than soil application, therefore, if there is no value, the default value is soil decay rate.		
25 (3)	Applicability Conditions	*Distinction between Low- and High-Tech Pyrolysis* We think that the criteria for the distinction between Low- and High-Tech Pyrolysis are insufficient. For the for Low Tech Pyrolysis there should be a minimum standard that is carefully defined. The current	The methodology is agnostic regarding technology. The methodology provides a framework for GHG accounting independent of the type of technology used. For both technologies, the GHG emissions (especially methane) have been considered.		

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		definition could include technologies that have way higher methane emissions than the most common low-tech pyrolyzers (Kon-Tiki or rotary Kiln). Furthermore, while the criteria for high-tech pyrolyzers can easily be met by the most common low-tech pyrolyzers (Kon-Tiki), some of the low-tech criteria are met by high-tech pyrolyzers. Thus, we think that the distinction between the high- and low-tech is insufficient and should be revised. For further detail please see the Appendix.			
25 (4)	Project Boundary	*"Low technology systems are provided a default emission value based on published literature"* (p.13) As mentioned before, low-tech technologies may vary highly in terms of their process emissions (particularly methane). Assigning only a default emission value may significantly underestimate relevant emissions, causing more harm than positive impact. Reliable date for each pyrolysis plant type is necessary here!	We argue to maintain the formula. The calculation is already conservative and effectively yields higher emissions than removal potential (see sheet AnnexInformation)	Annex information? To what does this refer?	We argue to maintain the formula. The calculation is already conservative and effectively yields higher emissions than removal potential. The project proponent must seach for data for the pyrolysis type they will use if the default value will not be used
25 (5)	Baseline Scenario	*"Continuation of pre-project waste biomass disposal practices is the most plausible baseline scenario" (p. 14)* This is incorrect as soon as the regulatory framework concerning waste biomass disposal changes. This should be kept in mind. In general, we consider issuing avoidance credits to be quite tricky and trust is key. The baseline needs to come with a proper buffer and there need to be regular checkups in place to prove if this baseline scenario can still be considered valid.	The baseline scenario has been revised to reflect that waste biomass disposal practices refer to the year in which biochar is made. See also comment 14.7		

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25 (6)	Applicability Conditions	*Methane Emissions* Methane emission accounting for high-tech production should be included!	Please refer to comment 6.1		
26 (1)	Additionality	*Durability of the Additionality Criterion*. In Appendix 1, the total available biomass for conversion is incorrectly estimated as 1 521 073 296 metric tonnes. There is a mistake in the calculation of the mass equivalent of the cubic meters of wood waste available. 336 858 637 cubic meters has been multiplied by 1.25, but should have been divided. When corrected we find an estimate of 1.1 plus 0.269486910 giving 1.369 Gt instead of 1.521 Gt, for the total annual worldwide feedstock resource. 5% of this is 68.45 million tonnes, rounding off some of the spurious precision. On my understanding of the argument, so long as the biochar produced annually does not consume more than this amount of biomass, the proposed additionality criterion would not be violated. Let's consider how much biochar could be produced from that amount of biomass. I suggest we should divide the raw biomass by 8 to estimate the carbon in the biochar, because there are three multiplicative factors of ½: - Half the mass of dry (not oven-dried) wood is water; - Only about half the mass of oven-dried cellulose is carbon; - About half the carbon is lost to gases and condensable liquids during pyrolysis. Each of these statements is approximate but not wildly so. Those who claim much higher yields	The wood waste portion of the calculation has been corrected, although it did not have an impact on the calculation of APy. The commenter suggests taking 5% of the total waste biomass produced annually (68.45 million tonnes) as the metric for calculation of APy, which is incorrect. However, it is true that multiple tonnes of biomass are needed to produce a tonne of biochar. If we assume an average yield of 20%, then it will require 5 tonnes of biomass inputs to produce 1 tonne of biochar. The current global estimate of biochar is 0.773 million tonnes, so that reflects utilization of 3.8 million tonnes of biomass per year. Using this approach, the APy value would be 0.27%. Even if we assume a 10% yield of biochar per biomass input the APy would only be 0.50%. Both values are well below the 5% threshold required by the *VCS Standard* (see *VCS Methodology Requirements* Section 3.5.9).	Further, per the VCS rules, the standardized activity penetration method needs to be re-visited every 5 years or less with updated data. So all of this will be checked and changes made within timeframes mentioned by the commenter	The wood waste portion of the calculation has been corrected, although it did not have an impact on the calculation of APy. The commenter suggests taking 5% of the total waste biomass produced annually (68.45 million tonnes) as the metric for calculation of APy, which is incorrect. However, it is true that multiple tonnes of biomass are needed to produce a tonne of biochar. If we assume an average yield of 20%, then it will require 5 tonnes of biomass inputs to produce 1 tonne of biochar. The current global estimate of biochar is 0.773 million tonnes, so that reflects utilization of 3.8 million tonnes of biomass per year. Using this approach, the APy value would be 0.27%. Even if we assume a 10% yield of biochar per biomass input the APy would only be 0.50%. Both values are well below the 5% threshold required by the *VCS Standard* (see *VCS Methodology Requirements* Section 3.5.9). Lastly, per the VCS rules, the standardized activity penetration method needs to be re-visited every 5 years or less with updated data. So all of this will be checked and changes made within

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		of biochar from a given feedstock are either working with high-ash material or are not driving the conversion far enough to produce a stable biochar. If we divide the 'permissible' feedstock of 68.45 million tonnes by 8 we get 8.55 million tonnes. Present production is estimated at 0.773 million tonnes annually. We believe production is expanding rapidly so I suggest it might reach 8 million tonnes per year in only 5 or 10 years. That implies that the lifetime of the Additionality Criterion may be quite short.			timeframes mentioned by the commenter
26 (2)	Applicability Conditions	Sewage sludge ('biosolids') from wastewater treatment should be included as a source material. This is a severe omission and might seriously constrain an important development area for biochar projects. I accept it may be difficult but the biochar so produced should be judged on its merits (as assessed by analysis) rather than by assumption of guilt before trial. Biochar from sewage sludge might be used in asphalt even if occasionally higher in some heavy metals, for example.	<u>Please refer to 15.2</u>		
26 (3)	Quantification of GHG Emission Reductions and Removals	*Sign conventions, notation and units in the equations*. For example, in section 8.2.1 equation (1) is written as a sum with subscript y; in mathematical convention that would imply a sum on y, whereas the y subscript just indicates the year y as a label. I suggest the equations could be made easier to understand if the subscript "y" were dropped throughout and the words around each equation specified that it	Equations and units have been revised and updated Equation 1 has been updated (converted - to +) Equation 3 can be maintained since project emissions will be a positive value and hence deducted from the Sequestration potential (CCy) The description of C has been updated in Equation 4. Equation 8 has been restructured to maintain consistency. The respective		

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		referred to a single year. What is the sign convention for equation (1) and indeed elsewhere? If BEss is zero but PEss non-zero then ERss will be negative – is that what is intended? A worked example following each equation would improve clarity very considerably. I have difficulty linking this to equation (3). In equation (3) the left side ERps is surely a positive quantity but that implies that on the right side, PEps is positive (so that the removals are reduced by the emissions?) In equation (4) the units seem to be inconsistent between the left and right sides. Would it not be better to use tonnes of C throughout with a conversion to CO2e at the end? On the left side of equation (4) the note says the units of CCt are tCO2e whereas the quantities on the right side (specifically Mt) are in tonnes. I have the same problem with equation (8) on page 25. Also on this page the paragraph describing PRde talks about Fperm but that is apparently the same thing.	equation 17 had to be updated accordingly		
26 (4)	Quantification of GHG Emission Reductions and Removals	Equation (11) on page 27 is another example of untidy notation: the SUM term has subscripts y and t but the summation is on the label t (not on y which is just a label). I suggest as before, that the y subscript be eliminated and replace by statements, as often as necessary, to the effect that the assessment refers to a single year.	The equations have been updated; the SUMs indicate the respective summation and labels have been removed.		

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26 (5)	Quantification of GHG Emission Reductions and Removals	In equation (12) the sum is correctly indicated as over the label "i" and the use of y as a subscript is potentially confusing.	No change implemented: The summation accross all energy types (i) is required.		
26 (6)	Quantification of GHG Emission Reductions and Removals	Equation (13) – inconsistent use of subscripts, suggest drop the "y" on the right hand side.	Formula maintained.		
26 (7)	Quantification of GHG Emission Reductions and Removals	Page 30. I am not comfortable with the neglect of transport emissions over a distance a large as 200 km. Repeated transport of small quantities of biochar over significant distances could reduce (or nullify) the net storage.	The 200 km limit is aligned with CDM Tool12 *Project and leakage emissions from transportation of freight*. The limit remains.		
26 (8)	Quantification of GHG Emission Reductions and Removals	After equation (16) on page 31 CCtl is defined in the notes but does not appear in the equation, whereas FCp does appear in the equation.	Equation has been revised and modified.		
26 (9)	Quantification of GHG Emission Reductions and Removals	Section 8.4.1.2 – biochar-infused plastics may be combusted at end of life.	Plastics as an end use has been excluded from the current methodology version.		
27 (1)	General	Earthworm Foundation is an impact-driven non-profit that works on the ground to create conditions for nature and people to thrive. Partnering with businesses, civil society and governments, it focuses on implementing responsible sourcing commitments in value chains, innovating practical solutions to the social and environmental challenges of production practices, and catalysing industry-wide chain reactions to help achieve transformation at scale. In this context, EF is working with charcoal retailers, importers, and producers to transform the charcoal supply chain.			

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		In particular, EF teams have been placing a strong emphasis on bringing transparency to a very opaque industry. EF began working on charcoal in 2013 by analysing market trends (imports and exports) and linking these to environmental and social injustices in supply chains of the charcoal imported into Europe. EF has been conducting field work and bags analysis in this space ever since. In 2019, EF launched the Charcoal Transparency Initiative, a platform for the European charcoal industry, which connects actors involved in responsible charcoal and helps educate consumers about the social and environmental impact of the charcoal they buy. The platform can be accessed here.			
27 (2)	General (Integrity of credits)	Going further, EF seeks to engage its members towards adopting regenerative practices. Biochar, having beneficial agronomic properties and being, by definition, a carbon sink, can participate in this regenerative approach. We understand the importance of carbon credits in building momentum for the development of the biochar industry and biochar success as a credible climate solution. However, we also worry that carbon credits might create incentives for irresponsible actors to enter the market. Today, several risks threaten the integrity of carbon credits as well as the climate potential of biochar at all stages of the supply chain: • At the sourcing stage, the lack of transparency regarding the biomass origin means that carbon credits could unintentionally sanction biomass sourcing associated with	Thank you for your feedback		

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		forest degradation and/or deforestation and other environmental degradations. This is a risk heightened by the lack of volume transaction monitoring prevalent in the industry. • At the production stage, the very relevance of biochar as a climate solution rests significantly on the environmental performances of the carbonization technology. Carbon credit standards therefore must be able to account for the technology used toproduce biochar and the associated GHG emissions. • Carbon credits for biochar projects must necessarily include the application of the biochar within the project boundaries. Indeed, when leaving the factory, the biochar is only a potential carbon sink, it only becomes an actual sink once it is applied. Therefore, the integrity of carbon credits is dependent on the Standard's capacity to control for the end-use of the product. Without such capacities, risks of fraud are high. Therefore, we would like to applaud VERRA's effort to set stringent guidelines to ensure the sustainability and credibility of carbon credits awarded to biochar projects and would like to suggests some additions. This document constitutes EF's contribution to the public consultation launched following the release of the Methodology for biochar utilization in soil and non-soil applications ("the Standard" thereafter). We have distinguished between comments on specific points in the Standard, questions and recommendations when we believed it was warranted.			

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27 (3)	Definitions	Chain of custody is defined by the International standardization organization (ISO) as "process by which inputs (3.2.2) and outputs (3.2.3) and associated information are transferred, monitored and controlled as they move through each step in the relevant supply chain (3.2.1) (Source: https://www.iso.org/obp/ui/#iso:std:iso:22095:ed-1:v1:en). Hence, any standard must document the whole supply chain activities from the source to the final product as well as its application. In our understanding, the term chain of custody for biochar should thus incorporate all steps of the production from the source (e.g. forest) to the sink (e.g. farm land). Yet, in the current wording of the Standard's definition, it seems as though the chain of custody starts at the production facility rather than at the biomass source. Recommendation: Based on EF experience, certification schemes with weak or incomplete COC supply chain verification systems can be exploited by "irresponsible" companies. This can lead to significant reputation loss to the certification scheme by CSOs. EF recommends that each biochar supply chain verified under VCS can be traced all the way back to the biomass source.	The chain of custody definition has been modified. Also, the boundaries has been clarified to reflect that it is from the sourcing stage until the end-use application		
27 (4)	Definitions	The term waste biomass, as defined in the Standard, indicates a previous commercial activity, which resulted in a by-product considered as "waste" or residues of a biogenic resource which cannot be used for its primary	Table 3 details the sustainability criteria for every feedstock category. The project proponent shall present the evidence to the VVB that reflects that initial waste biomass comes from a sustainable sourcing.		

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		industrial application. For EF, the sustainability and proof of sustainable management of a feedstock needs to be guaranteed to classify the waste or residues as eligible for sustainable biochar production. A transparent and clear documentation on the origin (e.g. a resource suppliers' list) should be publicly available.			
27 (5)	Applicability Conditions	Could you please clarify what "practice" refers to? Is it the practice of collecting the residues or the agricultural practice itself? Recommendation: The Standard requires that "primary raw woody sources coming from forests must prove that biomass comes from sustainable sources". EF suggests for the standard to include similar requirements for biomass waste to come from sustainable agricultural practices. Such requirements could include: • No agricultural waste from land that was subject to forests conversion after 2015 • Agricultural waste must come from organically managed fields	It refers to the implementation of the project activity. The paragraph has been updated. Recommendation on avoiding forest conversion has been considered. However, the methodology is applicable globally where organic fields requirement would be too restrictive. Therefore, the second recommendation has not been included.		
27 (6)	Applicability Conditions	p.9 What falls under the definition of by-products from forest-based industries? Do charcoal fines, produced as by-product of charcoal production, fall under the definition if charcoal production initially used logs, which did not show any indication of defects or inferior quality? Do wood classification systems have any relevance for the exclusion or inclusion of forests logs/residues as eligible feedstock?	by-products refers to wood chips, off cuts, sawdust for example. Charcoal does not fall under this definition. If the material has commercial value (e.g. as a plywood or wood pellet product) it would not be a waste product and hence ineligible as a feedstock.		

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		• Are logs classified as “firewood“ considered as forest residues?			
27 (7)	Applicability Conditions	Could you please elaborate on the term “overstocked”? Do you consider thinning operations in later forest stand development statuses also eligible as feedstock? Comment: Without more precision on the meaning of “overstocked”, one could justify that any wood from thinning operations in general can be used for biochar production. As a result, almost all of the wood, except the final harvest, could thus qualify as eligible feedstock for biochar production. The average growing stock varies depending on the forest biomes and regional forest characteristics. In Europe, the growing stock varies from Sweden 130 m3/ha to Germany 355 m3/ha (https://fra-platform.herokuapp.com/SWE/fra2020/growingStock/). Recommendation: Defining what overstocked means in the respective context should be based on robust data and context specific. In the absence of solid and robust data about the wood stock available, wood resources from “Forest and other wood processing” as defined in the Standard should not be eligible for biochar production.	Overstock has been defined. Also, the thinning coming from that operation shall have no commercial value to be classified as waste biomass.		
27 (8)	Applicability Conditions	p. 9/10. forestry certification including but limited to Programme for the Endorsement of Forest Certification (PEFC) and Forest Stewardship Council (FSC) or meeting requirements of Renewable Biomass as defined by the CDM tool	Text has been corrected. it should read "not limited to"		

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		(EB 23Report Annex 18). “Including but limited to”. Was this meant to say “including but NOT limited to”? Otherwise, said certifications have proven to be flawed and these certifications alone should not be the only proof of sustainable forest management required. In 2021, the environmental NGOs Earthsight and Greenpeace released damning reports targeting certification schemes in the forest sector, documenting how certified wood continues to be linked with forest degradation and illegal logging. While the Standard has a requirement for primary raw woody sources, it has no requirement regarding the forest source of wood-industry by-products. However, based on our experience, sawmill and other wood-processing facilities’ residues often contain significant shares of illegal and/or non-certified wood. Without traceability requirements for wood-processing waste biomass, carbon credits thus risk indirectly condoning such practices. In light of EF’s experience with the charcoal industry, cases of fraud typically occur due to a lack of volume transaction checking. In such settings, a producing company can source its biomass from certified and legal sources and then buy additional charcoal for resale from much less responsible producers. A lack of volume transaction monitoring can thus lead to the illegal wood laundering.			

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27 (9)	Applicability Conditions	Recommendations: Although we understand the difficulty of tracing residues back to the forest source, EF suggests requiring: • A risk analysis of the area in which residue suppliers source their biomass • The certification of the wood-processing facility • The knowledge of the country of origin of wood residues Further, we recommend that the Standard require producers to present robust volume transaction verification systems where the volume of biochar can be compared with the volume of raw material biomass. Wishing to reinforce transaction monitoring, EF developed methodology to monitor incoming wood sources, charcoal / biochar production yield and delivery to make sure that declared numbers are coherent.	Sustainable criteria requirements and the monitoring system are two criteria for avoiding illegal deforestation. Comment on input vs output has been considered	Please clarify what is meant by "comment has been considered". It's unclear if a change was made or not	Sustainable criteria requirements and the monitoring system are two criteria for avoiding illegal deforestation. Comment on volumen transaction from waste biomass input vs biochar output has been considered and added in the Table 3: "Residues from food processing facilities. Production of residues per output of the facility must not have increased to be used specifically for the purpose of production of biochar"
27 (10)	Applicability Conditions	p. 11 The methodology is not applicable if the project activity leads to a decrease of other carbon pools especially SOC on agricultural lands, or excessive removals of forest woody debris or litter. For example, collection of dead wood from a forest. Question: How is carbon pool degradation determined? In the case of forest residues numerous forest-related studies have proven that leaving forest residues after harvesting in the forest enhance the vitality and biological activity of the forest soil, regenerating the nutrient and water household of the same and that conversely removing forest harvesting residues has negative	Carbon pool reduction is determined by measuring the carbon pool at the baseline scenario and later with the implementation of the project activity. The baseline sceranio is outlined in section 6	I don't think this is an accurate response. There is no requirement to measure SOC stocks in baseline and project scenarios. Rather the requirement for ag wastes is no more than 50% of residues can be removed, with the assumption that that will not lead to decay. For forestry residues, it is more open ended	There is no requirement to measure SOC stocks in baseline and project scenarios. However, the project proponent shall prove that no more of 50% AGR waste biomass is removed from the sourcing site. This is in line with scientific information on the the assumption that the removal will not lead to decay. For forestry residues, the sourcing material shall come from sustainable sources. Please refer to Table 3: Sustainability criteria

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27 (11)	Project Boundary	p. 12 The abstract concerning "Feedstock production": Excluded. Waste biomass are considered renewable per eligibility condition EF comment: EF would like to raise comments and concerns that this definition can lead to significant logic as well as calculation gaps in determining the carbon sink potential of biochar. The supposed carbon neutrality of biomass has been the subject of much debate and has been called out by multiple actors at the European level. The EU commission has announced the commissioning of a comprehensive assessment of the biomass supply and demand in Europe to ensure that biomass-related policies are sustainable. Further, in the EU Commission's biodiversity strategy it is highlighted that "The overall objective is to ensure that EU regulatory framework on bioenergy is in line with the increased ambition set out in the European Green Deal". As an example the paper lists the following statement "The use of whole trees and food and feed crops for energy production – whether produced in the EU or imported – should be minimized" (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1590574123338&uri=CELEX:52020DC0380). Finally, even if GHG emissions from feedstock harvest can be minimised, they can never be zero (emissions due to forestry machinery / transport and local disruption	Waste biomass is considered as renewable based on Renewable Biomass as defined by the CDM tool (EB 23 Report Annex 18. The CDM tool is an approved methodology for carbon accounting. Also, the methodology is based on using waste biomass, and not purpose grown crops where emission would have been accounted. Emission from transportation are included as leakage		

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		of the ecosystem's carbon cycle will always be present). These emissions are too difficult to measure for all cases but can be estimated. EF is currently developing a tool to calculate the carbon footprint of various charcoal sources. Please do not hesitate to contact us if you would like to discuss our methodology. Recommendation: EF suggests developing a weighing system to take into account that the carbon footprint of biomass differs depending on the source (at least from country of origin to country of origin). Question: What about imported biomass for biochar production? Are the emissions from transportation included?			
27 (12)	General (Project development)	How do you check/assess the different technologies? Are auditors trained to evaluate the different types of technologies? Based on our experience, carbonization technologies vary in type and extent. Are there technologies, which are not admissible by the standard? E.g. traditional carbonization technologies or rather primitive, low technology systems (e.g. Ukrainian drum kiln)? Recommendation: Biochar projects using low technologies should not be able to receive carboncredits	the methodology outlines the technology criteria but its goal is to remain technology agnostic.low technlogies have been set up with conservative default values		

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28 (1)	Applicability Conditions	"Utilization of Biochar in soil application is likely to be reliant on agricultural seasonal cycles. In an adverse scenario where the project developer loses a biochar off taker for some share of the biochar production, it might take more than one year before returning the biochar to the soil. Indeed, it could be reasonably assumed that it might take several months to find a new off taker for the product (commercial prospection and negotiation). Therefore, if the appropriate period of the year is passed, it might be necessary to wait another year to place the biochar at the right season on top of the transitional period to find a new biochar off taker. Moreover, this criteria might introduce an asymmetric bias between biochar producer and biochar off takers at the advantage of the later. Knowing this constraint potential biochar off takers are likely to linger commercial negotiations in order to negotiate discounted biochar price." "Considering the properties of the biochar decrease marginally if not over time we propose the following change: 4. Applicability Conditions Eligible biochar end-use application criteria ""Biochar is eligible to be utilized and accounted for under the methodology if it is being utilized within two years of its production."""	Biochar is subjected to natural decay and permanence of biochar is calculated for a period of 100 years. To adhere to the decay factor established for 100 years, biochar must be utilized in soil or non-soil application, as appropriate, within the first year of its production. Also, carbon removal credits can only be claim if biochar has been used in an end application		
28 (2)	General (Project development)	Can you give some example of reliable documentation so as to guide the Verification and Validation Body and avoid discrepancy between certification bodies as to what is a reliable documentation ?	Reliable information such as a decay rate analysis. Further, the sentence has been re-written to show the requirement		

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		Add a few example of reliable documentation			
28 (3)	Additionality	"Biochar projects are complex and long-term projects requiring to mitigate many uncertainties and relying on several supply and offtake contracts to be negotiated and put in place. In order to scale up the number of biochar projects it is necessary to give the right signal to all biochar project participants limiting uncertainties where possible. As such, it is important that the eligibility of biochar projects is perceived as currently achievable and as remaining achievable for a period of time consistent with biochar projects typical time frame and related contracts commercial terms. We believe, the five percent threshold is too low and will give a wrong signal to project participants that the penetration criteria is only certain to be met by the first batch of biochar projects." Proposed change: Adopt a treshold of at least 10%	If there is rapid growth in the biochar sector, it is true that the APy value may exceed 5% at some point in the future. In Section 3.13.1(2) of the VCS Standard version 4.0 "the project proponent shall demonstrate to the validation/verification body that the simplified procedure is appropriate to apply to the project considering the project characteristics…". And furthermore, "Failing this demonstration, the project proponent shall not use the simplified procedure for demonstrating additionality and shall instead use an appropriate additionality assessment method in substitution". In the event of strong growth in the biochar sector that exceeds the 5% value--a project proponent will have to provide an alternative assessment of additionality that meets VCS criteria.		
28 (4)	Additionality	It is unclear whether, after such re-assessment of the penetration rate, it could prevent already certified projects to generate verified carbon credits in the future. Proposed change: Clarify that additionality of the project cannot retroactively be denied because of the three years penetration rate reassessment outcome.	This is clarified in the *VCS Standard* guidelines and *VCS Methodology Requirements*.		
28 (5)	Additionality	"It is our understanding for two different biochar projects developed (certified) in the same given	Our current calculations on additionality shows that the current global estimate of biochar is 0.773 million tonnes, so that		

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		geography but a few month interval before and after the penetration rate re-assessment, one could automatically meet the additionality criteria while the author would have to undergo the full barrier demonstration process. Such uncertainty is likely to discourage biochar project developers to invest in early stage but time consuming and costly project development activities and to impact the scalability of the biochar solution. Project developers might be inclined to disregard country with an already existing project. Proposed change: If the penetration rate is not exceeded locally (country wise), the project developer should not have to undergo the barrier demonstration.	reflects utilization of 3.8 million tonnes of biomass per year. Using this approach, the APy value would be 0.27%. Even if we assume a 10% yield of biochar per biomass input the APy would only be 0.50%. Both values are well below the 5% threshold in the VCS standardized approach to additionality.		
28 (6)	Quantification of GHG Emission Reductions and Removals	8.2.1 p.17 Wording ? "Emissions **reductions** at the feedstock sourcing stage are estimated as the sum of the difference between baseline emissions and project emissions in a given year according to the following equation:"	Wording has been corrected		
28 (7)	Quantification of GHG Emission Reductions and Removals	"Decreasing at a so low level the H:Corg ratio means in practice that the technology (whatever it is) will need to operate at much higher level of temperature (>500°C) and will drastically reduce the yield of conversion of the initial biomass. Said differently, production cost of biochar will increase further requiring a higher additionality effect through the CDR economical contribution. Since existing methodologies	H:Corg has been revised. Currently it is H:Corg<0.7. Permanence values have been updated based on temperature production using IPCC values.		

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		(PURO.earth, Carbon Future) set an acceptable and although challenging threshold at H:Corg<0.7 and O:Corg<0.4, supported by professional organization such as EBI, EBC ..., it is very disturbing (for project developer ready to launch new biochar capacities based on ""published and agreed"" criteria) to fit with another standard that will be much more difficult to reach and will for sure jeopardize the scaling up of this promising biochar solution. We strongly advocate that you take into account the well known paper from Spokas (Review of the stability of biochar in soils: Predictability of O:C molar ratios, Dec. 2010), which clearly established that O:Corg is much more relevant (compared to H:Corg) to predict half-time of the carbon (in biochar) : Spokas set up O:C molar ratio at 0.4 which was corresponding to a much more permanency ratio criteria of biochar carbon stability estimation. Considering the above, we wonder if there may be here some confusion between H:C and O:C ratios ? Please advise" Proposed change: "Keep ratios @ O:Corg<0.4 and/or H:Corg <0.7 well known and used by current players Review the decay rate (0,3%/year) which sounds too much conservative compared to other scientific references EBI's recommandation should be considered"			
28 (8)	Leakage	"It is unclear how long the obligation to monitor a GHG risk event shall apply and whether this limited to one year or if it extends to the full crediting period.	The project proponent shall provide proof of biochar application for carbon credits to be issued. Please refer to the bullets points at the end of the section.		

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		It might prove extremely complex and costly to monitor and justifying GHG risk events have not occurred for batches of biochar applied several year ago on small land parcel" Proposed change: Assuming the provision listed at the beginning of the section 8.4.1.1 have been complied with so as to apply biochar on soil and limit natural leakage risks , the project developer should be exempted to monitor the occurrence of GHG risk events			
28 (9)	General (Project development)	Please consider adding a specific section detailing the crediting period and the renewal process if any	Please refer to *VCS Standard v4.1*. This is outlined by the Standard, not the methodology.		
29	Applicability Conditions	Wollastonite is very similar to Biochar. It will capture co2 for centuries-millennia. It increases plant growth and is often compared to biochar as a SIlicon amendment. Could this methodologie be also used by Wollastonite? https://soilsatguelph.ca/trapping-carbon-with-wollastonite/ Using Wollastonite and Biochar together would be even better. The usual term for the Wollastonite co2 capture is Enhanced weathering but it is often looked at apart from it's effect of vegatative growth of plants and trees. By replacing Lime with Wollastonite we would reduce by 50% de co2 emission. In Québec we spread approx 350,000 tons per year. Lime and Dolomite (dol-lime) is used to increase the pH of the soil and supply calcium, an essential plant nutrient. But these carbonate	Currently the methodology focuses on the application of biochar produced from waste biomass, thus enhanced weathering is not applicable. Nonetheless, Verra's newly launched CCS+ initiative is working to develop new VCS methodologies where enhanced weathering may be included as a project activity.		

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		minerals are full of carbon, and when they break down, they will release 25% to 44% of their weight as CO2 to the atmosphere. Wollastonite is a carbon-negative replacement for lime products that can remove instead of add Co2 to the atmosphere. In a recent study, beans showed a 177% greater dry biomass weight, and corn showed a 59% greater plant height and a 90% greater dry biomass weight than the control while capturing 9x more CO2 from the atmosphere. https://www.canadianwollastonite.com/wp-content/uploads/2019/01/CO-Benefits-of-Wollastonite-Weathering-in-Agriculture.pdf			
30 (1)	General (International standards)	Important that Verra also recognises the ANZ Biochar Industry Group Code of Practice (COP), in addition to IBI and EBC guidelines, as it is soon to be finalised (draft issued for consultation is being finalised by November 2021). This COP establishes three grades of biochar (each with sub-grades based on carbon content) that align to applications ranging from Industrial, Standard to Premium Chars (eg feed chars). The consultation period for our draft ANZBIG COP has been several months, and we'd recommend longer consultation on the draft Verra method for wider industry consultation globally due to time commitments and impacts (including Covid-related of course).	The methodology developers recognize the ANZ biochar industry group. However, to date, there is not a finalized version of the Code of Practice that can be included in this version of the methodology.		

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30 (2)	Quantification of GHG Emission Reductions and Removals	The well-established H/Corg (hydrogen to organic carbon) method of assessing biochar stability could/should be considered.	The H:Corg has been considered to set the limit for biochar. The limit is set at H:Corg <0.7		
30 (3)	Applicability Conditions	Mixed Animal bedding (eg manure & sawdust, eg poultry litter) should be included in Table 3 as eligible sources.	Sawdust and animal manure are included in Table 3. The project proponent should be aware of the eligible feedstock and production eligibility criteria outlined in Section 4 regarding mixing of feedstock.		
30 (4)	Applicability Conditions	Blending options (biomass with other co-feeds) should be clarified further.	Please refer to comment 13.1		
30 (5)	Applicability Conditions	Table 3 "Recycling Economy"- use of urban green waste should also control other common cross-contaminants in it, particularly plastics (due to associated pollutant risk, eg dioxins/furans).	Table 3 has been revised and updated. Green urban waste shall comply with international standards or guidelines for use as feedstock.		
30 (6)	Applicability Conditions	Use of municipal biosolids should be considered alongside animal manures, acknowledging appropriate applications pending resulting biochar quality/grade (eg industrial use vs agricultural).	Please refer to comment 30 (9)		
30 (7)	Additionality	Appendix A – are we correct in understanding that the quoted MAP figure of 1.5B tpa (noting only for wood and crop residues) and the 5% threshold placed for additionality would equate to 75 Mtpa max biomass available globally for biochar production? Shared between 195 countries globally (there are nearly that many signatories to the Paris Agreement) = only 384 Ktpa each if shared equally. Granted whilst biochar global production in total is <1 Mtpa, China's production alone already exceeds 500,00 tpa as quoted and aims for 3Mtpa in near future, with other areas of the developed world expecting to follow suit in order to meet Net Zero	Yes, the 75 million tons per annum value is correct. See response to comment 26 above for more details. If there is rapid growth in the biochar sector as you describe, it is true that the APy value may exceed 5% at some point in the future. In Section 3.13.1(2) of the *VCS Standard v 4.0* "the project proponent shall demonstrate to the validation/verification body that the simplified procedure is appropriate to apply to the project considering the project characteristics…". And furthermore, "Failing this demonstration, the project proponent shall not use the simplified procedure for demonstrating additionality and shall instead use an appropriate additionality assessment method in substitution". In the event of strong growth in the biochar		

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		commitments which urgently require long term stable NETS (also noting NETs such as forestry are under threat, as attested to by the wildfire impacts in the US on the carbon securities held by the likes of Microsoft who are now looking for more secure NETs in their portfolio. Biochar represents such security. This may lead to non-linear uptake (indeed potentially exponential) and this (in addition to other commercial co-benefits not offered by other NETs like DAC etc) is why some studies such as Grandview Research are suggesting that the global biochar market size for biochar is estimated to reach USD $3.1 billion by 2025 and It is expected to expand at a CAGR of 13.2% over the forecast period (Grand View Research 2019). Accordingly, it is recommended that the MAP figure quote could quickly become constraining and the 5% threshold should be considered more closely. Indeed as a minimum some assurance that it will be revised (upwardly) would be required in order for Biochar to attain the Gt scale potential quoted on the very first page of the method (1.1 Gt).	sector that exceeds the 5% value--a project proponent will have to provide an alternative assessment of additionality that meets VCS criteria.		
30 (8)	Applicabilit y Conditions	Development of the mentioned potential future inclusions for Purpose-grown biomass (both terrestrial and aquatic) should be considered as a priority, and can be done sustainably (e.g. exclude biomass grown in high value cropping soils areas to deter such practices (avoiding criticism for competition with rightful higher need/priority for food production). Otherwise may prematurely	Please refer to comment 6.2. Purpose-grown biomass is currently not included in the methodolgy as it adds complexities regarding baseline scenario, monitoring, carbon accounting, leakage, other. However, the methodology has been designed in a way that allows the inclusion of new modules/tools in future versions.		

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		constrain significant emerging opportunities rather than encouraging them, especially for regenerating degraded land. o Eg residues from new aquatic biomass (eg macroalgae/kelp/seaweeds) opportunities. For example kelp residues sent into AD with digestate then pyrolyzed (or direct process via high moisture pyrolysis methods such as HTC/HTL etc).			
30 (9)	Definitions	S3 Definitions - Definition of Waste Biomass – "Biomass, by products, residues and waste streams from agriculture, forestry and related industries….". there are other biomass feedstocks and industries inferred in Table 3 that extend beyond this definition. Suggest this definition is widened to say (at least) Biomass, by products, residues and waste streams from agriculture, forestry and related/other industries including all those inferred in Section 4 (Applicability Conditions) and Table 3." This would capture those. For example urban green waste and invasive weeds (in Table 3) are neither agriculture, forestry or related industries under the current definition. o See also related comments below regarding feedstocks context to emissions reduction/avoidance vs sequestration/CDR…this has context to defining biomass vegetation feedstocks (that provide sequestration) compared to other feedstocks currently falling under the broad umbrella of "biomass" which provide emissions reduction benefits rather than CDR (eg animal manures/biosolids). This important	Definition of waste biomass has been revised and updated to make it clearer for the project proponent.		

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		context could be clarified further in defining biomass. See also related comment further below regarding the commercial need for mixing these feedstocks (e.g. vegetation biomass mixed with biosolids etc) to make more viable and effective biochars for various soil and non-soil applications.			
30 (10)	Applicabilit y Conditions	*Contaminant levels (including heavy metals)* - Any reference to all types of contaminant levels/criteria (including but not limited to heavy metals) throughout the document (eg Table 3) should be in context of being fit for purpose in context of end use application and associated relevant guidelines. For example non-soil applications may indeed be fine for higher levels of certain contaminants not suitable for soil applications (eg heavy metals in roads etc which are (even more) bound up and not bioavailable). This is why ANZBIG has established the three grades of biochar to allow a “horses for courses” approach to match biochar quality needs to end use applications, building on the initial work of IBI and EBC and others. The highest quality criteria is required for Premium grade chars for applications such as feed supplements, appropriate criteria for Standard Grades used in soils, and “lower” criteria appropriate for	Feedstock shall comply with relevant thresholds regarding heavy metals according to the final end use application, either in soils or non-soils. Table 3 has been revised and updated to reflect the comment feedback.	Other contaminants like PAHs or dioxins can be important and should also be considered	Othe contaminants have been added to the Table 3. However, the methodology is not intended to be a material standard or soil standard, and we can only reference to third party guidelines. The biochar methodology requires that biochar producers meet the material standards of the IBI or EBC. For example, in the IBI standards (Table A3.1) maximum allowable thresholds for biochar are listed which include PAH and Dioxins

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		industrial applications (industrial Grade chars). Table 3 current mentions that “Feedstocks must not contain heavy metals” (for urban biomass). This is neither realistic nor practicable as biomass in natural soils (without any anthropogenic contamination) includes varying levels of heavy metals (typically reflective of the natural soils and their geology/geomorphological origin). Further, total metals concentrations compared to leachable and bioavailable concentrations is an important consideration in any biochar application – is it fit for purpose? (soils vs roads vs carbontech vs concrete vs activated carbon biochar etc etc). Whether the final biochar exceeds relevant guidelines for bioavailability as appropriate for various end uses once processed in biochar is key to managing risk. Further, the relative risk presented by current accepted management activities globally such as open burning in both agriculture and forestry (hazard reduction) is a huge air pollution problem linked to many diseases (and indeed many deaths)…. alternative processing to biochar in both the developing and developed world presents a far lower relative risk to society than the status quo. Prescriptive criteria need to consider relative risk context in each application, just as we do with considering avoided CO2 emissions. ANZBIG is pursuing a risk-based approach to biochar production and use in its COP.			

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30 (11)	Applicability Conditions	S4 Eligible Feedstocks and production - Mixing of Feedstocks (co-processing) – As Verra has noted, biochar has suffered historically in market uptake due to factors including commerciality. It is inappropriate that mixing of feedstocks is prohibited as often a mix of feedstocks is beneficial for producing high quality biochar dedicated to a target purpose, giving greatest benefits (including as a soil amendment and non-soil applications too). Co-processing to create "Biofertilisers" with biochar and many other soil and non-soil applications has high potential for growth, and is being heavily pursued by the worlds leading biochar economy China, and many others. The proposed constraint in s4 of <10% blending and "no chemicals shall be used" will preclude many climate-beneficial project applications for biochar, and in particular is not relevant at all for non-soil applications (eg roads, concrete, bioplastics/carbontech)…indeed those aspects can be core to enhancing the final product characteristics required. We suggest that if the outcome sought is quantifying carbon credit value (as both emissions reduction/avoidance and/or CDR value) for a given process, keeping the narrative outcome focused to those objectives rather than prescriptive exclusion of processing could yield higher uptake and climate benefit across many existing and emerging biochar applications. We and others within ANZBIG would be happy to discuss	The individual biochar soil-persistence values in the methodology (PRde) are based on IPCC data backed by meta-data at a global scale. However, the mixing has been revised and updated in the methodology providing clarity in which cases it is allowed		

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		further if Verra seeks further consultation on potential options to resolve any issues to allow mixing of feedstocks.			
30 (12)	Baseline Scenario	Separation/Clarity of accounting Emissions Reduction/Avoidance and CDR/Drawdown - We support the option to include avoided emissions in baseline considerations, but also note the critical importance of ensuring clarity and separation in disclosing both Emissions Reduction/Avoidance values separately from sequestration/CDR/Drawdown. Net Zero ultimately requires both to be integrated for a net result of course, but clarity in separated accounting is vital as noted by a number of environmental economics and climate proponents globally (see article from Carbonbrief here). This is particularly important for animal and human manures (agricultural and municipal biosolids) where the reduced/avoided emissions benefits are high, but CDR benefit is low (but resulting biochar is of importance and value in end-use application so should be encouraged)…what matters is the accounting declaration.	Please see comment 23.2		
30 (13)	Baseline Scenario	Nitrous Oxides - The avoided emissions for biochar applications involving nitrous oxides (eg N2O) could/should also be considered due to their significance as a GHG and their potential for substantial reductions when integrated with biochar (eg in composts and agricultural soils among many others including agricultural and municipal	There is no clear effect of priming based on latest publication of Woolf, Lehman, et at (2021). Further, the scope on priming it is related to the SOC carbon pool, the project activity of this methodology is the application of biochar in soil and non-soil end uses. Therefore, the GHG emission associated with priming are outside the bounaries of this methodology.		

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		biosolids application to land vs conversion to and use of biochar).			
30 (14)	Baseline Scenario	Avoided emissions in non-soil applications for biochar such as roads and concrete can also be substantial.	The methodology / project boundary accounts for GHG emissions from sourcing of feedstock until the final application of biochar, either in soils or non-soils. Also, the project activity is the application of biochar. The avoided emissions referring to the use of biochar in other industries is out of the scope of this methodology.		
30 (15)	Applicability Conditions	Priming ("negative priming") benefits in soil applications has been scientifically established (see here and here) and should have potential for inclusion where suitably assessed and justified	There is no clear effect of priming based on the latest publication of Woolf, Lehman, et at (2021). Further, the scope of priming is related to the SOC carbon pool, and the project activity in this methodology is the application of biochar in soil and non-soil end uses. Therefore, the GHG emissions associated with priming are outside the boundaries of this methodology.		
31 (1)	Definitions	Page 6, 3. Definitions The use of the term "Fixed carbon content" should be reconsidered as it is traditionally used in Proximate Analysis (see ASTM D1762-84) to indicate the recalcitrant fraction of coal or charcoal used as a fuel (e.g. (Aller et al., 2017)). However, proximate analysis and the use of the term "fixed carbon content" is also common in current biochar research. As the fixed carbon to volatile matter ratio of biochar can be used to approximate biochar stability (Crombie et al., 2013), using the same term with a different meaning within this methodology will likely lead to misunderstandings. Therefore, to avoid confusion, the term "fixed carbon" as used throughout the proposed methodology should be replaced by	While your comment has been considered, we will continue to use "fixed carbon content". Please refer to comment 6.5 for futher information	Fixed Carbon Content was removed from definitions in the meth. Does this response still hold?	The fixed carbon term has been disscused and revised. Currently, the agreed term used in the methodology is "Organic carbon content on dry weight basis". The definition is more expansive because the methodology includes non-soil applications.

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		an alternative term (e.g. stable, permanent, secured, etc.).			
31 (2)	Applicability Conditions	Page 11, 4. Applicability Conditions: Biochar is eligible to be used in non-soil applications including but not limited to cement, asphalt, and plastics. For non-soil applications, project proponents must demonstrate that biochar is a long-lived and stable carbon sink using peer-reviewed literature and/or reliable documentation. We have doubts about the inclusion of biochar-amended plastics as an eligible non-soil application. While plastics might be long-lived and stable, the common use phase will not cover the whole timeframe relevant for carbon sequestration (i.e. 100 years). Therefore, biochar use in plastics is difficult to define as an end application and has to include the post-use application of the product as well. If any recycling method other than landfilling (which is being banned in various countries) will be used, some of the carbon will be released and the soil decay rate might not be applicable anymore. Furthermore, the risk of double-counting the carbon content will be present either when the material is recycled or if the used biochar plastic is utilised in other waste treatment technologies such as composting or anaerobic digestion. We suggest adding additional more strict requirements or limitations for the use of biochar-amended plastics, such as a positive list for eligible applications (e.g. the use of biochar amended plastics as soil cover foil).	Plastics as end use has been revised and is excluded from the current methodology version.	Please be sure to remove any reference to plastics as an end use throughout the new draft	Plastics as end use has been revised and excluded from the revised methodology version.

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31 (3)	Quantification of GHG Emission Reductions and Removals	Page 20: 8.2.2.1. Mass of biochar of type t applied to the respective end-use in the year y (tonnes)12, see application stage. The produced mass of biochar shall be determined in alignment with CDM tool 13 Option 1 using a weighing device or Option 2 without a weighing device. Using a weighing device only for determining the produced mass of biochar will certainly lead to inconsistencies. Biochar is well known to adsorb moisture from ambient air. Hygroscopicity can result in weight differences of more than 10%wt (d.b.) (Kymäläinen et al., 2015; Popescu et al., 2015). Therefore, any use of biochar weight has to be based on a dry basis by subtracting the moisture content of the biochar at the time of measurement. This is especially important as the carbon content of biochar is measured by dry-combustion and therefore reports on a dry basis. A combination of wet mass of biochar and the dry carbon content will artificially increase the calculated amount of stable carbon.	Moisture content has been revised and considered. The methodology points at the USDA moisture protocol as example. Further, the carbon content is based on dry weight basis.		
31 (4)	Quantification of GHG Emission Reductions and Removals	Page 20: PRde A clarification is needed for what decay rate will be used if biochar exceeds an H:Corg ratio of 0.4. Also, Budai et al. (2013) and Camps-Arbestain et al. (2015) are not included in the reference list.	H:Corg ratio is a metric to determine the level of carbonization of biomass material and therefore the biochar's stability. H:C org has been revised and clarification has been made about the limits.		
31 (5)	Quantification of GHG Emission Reductions and Removals	Page 21: Step 2: Estimate project emissions for high technology production facilities My,t – Should be changed to dry basis Mx,t – Should be changed to dry basis	Agreed and amended accordingly		

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31 (6)	Quantification of GHG Emission Reductions and Removals	Page 23-24, 8.2.2.2. Option P.2: Low technology production facility, FCp The organic carbon content values show a large variation highlighting discrepancies between production technologies. As the organic carbon content displays an inverse correlation to the biochar yield, the use of average values can provide incentives to produce biochar with lower than average carbon contents. This is because the use of lower production temperatures will maximise biochar yields and therefore financial gain, while lowering the actual carbon content and stability of the produced biochar. This would counteract the idea of long term carbon removal. We strongly argue against an average value as being an appropriate assumption to determine the carbon content of low-tech biochar. A sunset clause might be used to require the determination of the organic carbon content at some reference point after the individual project starts to allow a recalculation and ensures that the necessary laboratory analysis is not prohibitive. This could also provide the possibility of monitoring the applicability of the values used by the IPCC for future amendments.	The values for low technology are sufficiently conservative regarding the Fcp. The Fcp value consider the standard deviation deduction.		
31 (7)	Quantification of GHG Emission Reductions and Removals	Page 26-27: Emissions associated with the thermochemical process The average emission factor of 0.09 t CH4/t biochar might not be a conservative assumption. As outlined in the mentioned publication, the use of 100% herbaceous biomass led to much larger emissions of up to 0.15 t CH4/t biochar and this might be the	We argue to maintain the formula. The calculation is already conservative and effectively yields higher emissions than removal potential (see sheet AnnexInformation)	Annex information? To what does this refer?	We argue to maintain the formula. The calculation is already conservative and effectively yields higher emissions than removal potential. The project proponent must seach for data for the pyrolysis type they will use if the default value will not be used

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		case for many marginal feedstocks with varying moisture contents. As also stated by the author, CH4 emissions are relatively difficult to measure and also highly dependent on the operator, feedstock conditions, and rate of measurements. Additional research should be identified to bolster the claim of average CH4 emissions over various pyrolysis systems.			
31 (8)	Leakage	Page 31, 8.3. Leakage: Considered zero if the project proponent establishes that 100% of the biochar originally intended for the application stage is not lost before its application. The moisture content of the applied biochar must be measured to establish if 100% of the produced biochar is actually applied. Hydroscopic moisture uptake of biochar can easily disguise more than 5% biochar leakage.	Moisture content has been revised and considered. The methodology points at the USDA moisture protocol as example. Further, the carbon content is based on dry weight basis.		
32		PDF	The comments has been addressed directly in the document		
33 (1)	General (International standards)	Include the Australian and New Zealand Biochar Industry Group Code of Practice in addition to IBI and EBC guidelines, as it is soon to be finalised (draft issued for consultation is being finalised by November 2021).	We acknowledge the ANZBIG COP, however, it has not been approved. Furthermore, the methodology also points out that national /regional guidelines /standards can be followed.		
33 (2)	Quantification of GHG Emission Reductions and Removals	Further recognise H/Corg as the current best estimate of permanence to enable 100 year and 1000 year biochars to be acknowledged and valued.	We acknowledge the H/Corg paramether as described in comment 31 (4). However, the IPCC values for demonstration of permanence has been chosen in the methodology as a peer review and scientifc source		
34		PDF	The comments has been addressed directly in the document		

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35	Baseline Scenario	If I understand correctly the baseline emissions are assumed to be 0 in most cases and the climate impact of biochar is calculated based on the CO_2-eq content of the final product. But if biochar is primarily impacting the climate by displacing CH_4 emissions, wouldn't this be a low estimate in terms of GWP? Or is this a conservative approach based on the idea that decay emissions could include multiple GHGs, so project activities are based just on an estimate of CO_2-eq in the biochar?	Baseline avoided emission scenario has been set as zero following a conservative approach and in order to avoid double accouting.		
36	Applicability Conditions	Regarding mixing of feedstocks - dairy farms often bed their cows on sawdust, which gets mixed in with the manure. We have a project that makes biochar from manure. It seems odd that each of sawdust and pure cow manure, if otherwise left to decay or to be combusted, would be an eligible feedstock, but not if they are mixed (and mixed for reasons other than changing the composition of biochar). Can you make an exception for this case? Otherwise a lot of dairies will be left out of that potential revenue stream.	Please refer to comment 13.1		
37 (1)	Applicability Conditions	Feedstock mixtures of differing or mixed waste biomass types should not be excluded. It is possible to correctly account for the differing carbon content of the feedstock components and associated volumes. For example, there exists potential to mix woody biomass with manure to further increase the carbon content of the biochar product.	Please refer to comment 13.1		
37 (2)	Applicability Conditions	Request to include additional wood waste items in the definition of "Recycling economy" such as	Table 3 has been revised and upated. Please consider it is a non-exclusive example list.		

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		cardboard, wood pallets, and other wood waste.			
37 (3)	Applicability Conditions	Request to include non-soil application eligibility for environmental remediation, wastewater treatment, and other biological treatment purposes.	Environmental remediation is a soil application therefore it is included as an end use. The project proponent must prove long-term permanence for any final use of biochar.		
38		PDF	The comments have been addressed directly in the document		
39 (1)	Applicability Conditions	Purpose-grown feedstock is currently out of scope for the Verra protocol. This is probably to avoid competition for land with food resources. But what about fast-growing plants in marginal lands? How would these lands be identified? How could this be managed? Furthermore, the residue feedstocks in Table 3 could create increased competition with other uses (biofuels and energy production from biomass) that could lead to increased emissions with more land use change, and so these factors would need to be considered. Dedicated fast growing feedstocks on for example marginal land could mitigate competition for biomass.	Please refer to comment 6.2		
39 (2)	Applicability Conditions	How can it be ensured that feedstocks will not be mixed in low-technology pyrolysis cases? Smallholder production systems are given as an example for the low-technology scenario. These systems are highly diverse in space and time. Single feedstocks in these systems would be more realistic when aggregation of waste happens at a higher level than the farm. At that level, high-technology pyrolysis might be more applicable and lead to higher quality credits.	Please refer to comment 13.1		

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39 (3)	Definitions	What compositional measurements are included when determining the material change threshold?	Material change is defined in the methodology. However, the term has been revised since mixing is allowed and a laboratory analysis is required.		
39 (4)	Applicability Conditions	Although we do understand that the inclusion of the low-technology option aims at enabling access for smaller players, how will Verra ensure high-quality credits resulting from activities using the low-technology? Research has shown that recording temperature would be a minimum requirement to assess the persistence of biochar in soil. The consistency of credit quality can be jeopardized by not recording at least the temperature in the low-technology scenarios. While pyrolysis temperature and pyrolysis time at maximum temperature can vary in a project using low-technology, so will the quality and permanence of the resulting biochar. This can have a direct effect on the consistency of the quality of the credits and can lead to questions related to the integrity of credits resulting from projects using low-technology as well as high-technology in the market.	Conservative values has been taken to allow for the inclusion of low-technologies. The values are based on peer reviewed data and IPCC defaults.		
39 (5)	General (Energy production)	I don't seen anything about high technology that experts heat and energy that can displace and reduce fossil fuel use/emissions, would this be considered as part of this or accounted for separately in the renewables sector?	The project activity is the application of biochar either in soil or non-soils. The GHG emission reduction due to displacement of fossil fuels is not within the methodology boundaries.		
39 (6)	Quantification of GHG Emission Reductions and Removals	Given the large uncertainties in Table 5 on Fcp, why not allow projects to measure and demonstrate their actual feedstock Fcp values even for low technology? This would significantly reduce	The methodology states that a material analysis is preferred to determine Fcp. But when this is not possible, then default factor shall be used.		

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		subsequent uncertainty on the credit volumes issued from such low technology options.			
39 (7)	Leakage	Biochar oxidation can increase with transportation leading to leaching and lateral export with water. Currently, the risk for water erosion is estimated to be minimal in the proposed methodology. Does this include mobility?	Risk is only considered when biochar is applied to the soil. For anything lost during transportation, it is considered under leakage.		
39 (8)	Applicability Conditions	Can we assume that sequential additions of biochar on the same land are allowed under this methodology?	Yes, as long as the relevant national guidelines and best practices are maintained, this is an option. However, it is not the scope of a carbon methodology to advise on suitable application rates, which are determined by the local context		
39 (9)	Baseline Scenario	Given that biochar has soil carbon and GHG benefits when applied to soil why are N2O emissions not also considered under the anaerobic decomposition definition, I would think this baseline and then comparison with biochar amended to soil would result in significant reductions.	This methodology primarily focuses on the removal potential of biochar. The numerous and evolving application scenarios will be better reflected in other protocols, such as VM0042. It is therefore strongly suggested to look into these options.		
39 (10)	Applicability Conditions	Given the published literature on the varying effects of biochar addition on soil macro and microfauna, do VERRA propose constraints on land application rates both acute and chronic over time for a given area?	See above answer 39 (8)		
39 (11)	Applicability Conditions	The biochar combinations as a nutrient delivery mechanism with fertilizers would be excluded, yet would provide both carbon and GHG benefits in terms of subsequent slow release fertilizer delivery for plant uptake that would limit N2O emissions. This should be part of the accounting with projects for emissions reduction benefits.	See above answer 39 (9)		

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39 (12)	Leakage	The risk of loss from flooding or drought with biochar should have no effect on biochar stability or decomposition as evident by the age of charcoal present in coastal sediments deposited from natural fires and transported from the point of production by wind and water erosion. This is simply a measurement and accounting challenge for in situ based measurements. Fire would however potentially result in losses back to the atmosphere	Fire is considered a risk and in order to minimize it, the biochar shall be applied at a minimum depth of 10 cm since soil damage from wildfires is limited to the very top layer of soils	Per earlier comments, suggest better differentiating in the Risk section fire from all the other natural risks. Fire is really the key here	Fire and other natural factors are differentiated in section 8.4.1.1. of the methodology. However, erosion due to wind and water are still considered as reversal as the fate of biochar outside the project can not be determined and confirmed, applying the conservative approach a loss of biochar due to soil and wind erosion is considered as reversal.
39 (13)	Quantification of GHG Emission Reductions and Removals	Again on tables with default factors for feedstock carbon contents I would use measured rather than default factors.	See above answer 39 (6)		
39 (14)	Quantification of GHG Emission Reductions and Removals	The protocol lacks the ability to include additional emission reductions through measurement technology such as flux chamber and eddy covariance to directly assess the biochar effects on reductions in GHG emissions (specifically N2O and CH4). The protocol should allow for project proponents to demonstrate these benefits and additional credit volumes through the use of robust measurement and monitoring technology.	The potential avoided emissions of N20 or CH4 from soil following biochar application are beyond the scope of the methodology. The biochar methodology is a global methodology and trying to assign N20 and CH4 avoidance factors for all types of biochar in all types of soil is entirely impractical. Furthermore there is no scientific consensus on N20 or CH4 reductions following biochar application.		
39 (15)	Additionality	The activity penetration will be re-assessed within 3 years of the initial approval of the methodology. How will that affect the existing projects?	Please see comment 30 (7). The activity penetration reassessment shall not affect existing project implementation. However, when renewing a project crediting period, the project proponent shall use the most up-to-date methodology version (see *VCS Standard v4.1*, Section 8).		
40	General (Project	if ESG Partners was to do a biochar project meeting these guidelines in Australia, would we be able to get	Project proponents shall follow a country's climate policy agreements (NDCs) and be aware that there is no		

#	Section	Comment	Response 1	Verra comment 1	Response 2
	development)	VCS certification for it, for voluntary credits?	double accounting of climate benefits permitted.		
41	Applicability Conditions	We produce biochar from water weed – water hyacinth, Salvinia molesta, etc. These aquatic plants are not represented in the methodology. Isn't it? But these aquatic plants have a higher potential for biochar production than land biomass. And it's a weed.	Water hyacinth and water invasive species are within the classification "Aquaculture plants". Table 3 has been revised and updated. Please consider that the examples are non-exhaustive.		
42 (1)	Quantification of GHG Emission Reductions and Removals	The methodology does not account for the initial pulse of CO2 emitted during pyrolysis (e.g., Campbell et al., 2018), which will delay the positive GHG effect of the production / application of biochar depending on the efficiency of the process, the feedstock and the environment.	Cambell et al. 2018 considers the dynamics between forest carbon reductions from forest harvest (and the decay of slash piles over time) with biochar based pyrolysis and application. We do not believe the "pulse" or potential debit is an issue given sustainability criteria for forestry feedstocks and other eligibility requirments for biomass waste.		
42 (2)	Quantification of GHG Emission Reductions and Removals	The permanence adjustment factor PRde is based on Budai et al. (2013), a source about which I have many concerns: a. It is a surprise the authors did not even consider the H:Cfixed (Cfixed: fixed carbon as estimated by proximate analysis) as a possible estimator for PRde. Differently from the selected H:Corg, H:Cfixed does not include the labile portion of Corg, which is known to have a low permanence, i.e., I would expect H:Cfixed to be a better estimator of per-manence. b. The data set derived from two other studies is just too small to cover the plethora of biochars that can be produced from the diverse combinations of feedstocks and py-rolysis conditions. And even for this limited set the linear relationship	The IPCC guidelines and factors are global, rigorous, and derived from peer reviewed data.		

#	Section	Comment	Response 1	Verra comment 1	Response 2
		estimated only accounts for about 50% of the variability in the data, which is a poor result for the purpose of calibration, as is intended here. c. The estimation of permanence does not account for the impact of environmental fac-tors. d. This approach to estimate permanence was already objectively criticized as inade-quate by Noel Gurwick (and others) in the public comments (pg. 99 ff) to the biochar methodology submitted to the American Carbon Registry – a methodology which was never implemented in practice. e. The authors themselves anticipated their methodology would be outdated by 2021: "… with continued research and development … we are confident that the test meth-odology will grow more robust and more rigorous over time, allowing for a more com-plete and precise estimation of stable carbon in biochar."			
42 (3)	Quantification of GHG Emission Reductions and Removals	While accounting for low technology pyrolysis in the methodology has important social and environmental benefits, it is simply impossible to have a reasonable estimate of the biochar permanence adopting a unique universal factor (PRDE = 0.56 as stated on page 24).	The 0.56 value is a conservative assumption to estimate the bicohar permanence. However, when the project proponent can measure temperature and do a material analysis, then values from Table 5 should be used		
42 (4)	Definitions	The term "fixed carbon content" is unfortunate as "fixed carbon" is one of the quantities quan-tified by proximate analysis (i.e., what remains after subtracting the weights of moisture, vol-atile matter and ash from the sample weight) and proximate analysis is commonly used to characterize biochar. Would	Please see comment 6.5		

#	Section	Comment	Response 1	Verra comment 1	Response 2
		"sequestered carbon" be an alternative to "fixed carbon content" here? Additionally, shouldn't it be stated in the definition "… expressed as tCO2e" – at least this is what I depicted from equation (4), pg. 20.			
42 (5)	Applicabilit y Conditions	I do not understand the fetish in the biochar community with a limit for the heat recovery of the pyrolysis process when addressing the biochar's capacity to sequester carbon / remove CO2 from the atmosphere. Indeed, the recovery of the heat can contribute to reduce fossil fuel GHG emissions, something that should be addressed by other methodologies or as a sep-arate part of the present methodology, but this will often not be the case: in Brazil for exam-ple, in the countryside there is little or no use for the heat – hence, to recover it, it will be necessary to transport the feedstock over large distances and requires much more elaborate and expensive pyrolysis technologies, which will make the economic viability and adoption of biochar less likely.	Heat recovery is needed (to avoid use of propane or other fossil fuels) and it is within the project boundary		
42 (6)	Applicabilit y Conditions	The inclusion of purpose-grown biomass into the methodology would allow for and incentivize the remediation of degraded land, which is a worldwide problem: o the degraded land itself can be used for cultivation of the biomass – bamboo is an exceptional plant species for this purpose in tropical and subtropical regions: it can be planted in areas even severely affected by erosion, its rhizome helps stabilize the soil, it is fast growing and very productive;	Please see comment 6.2		

#	Section	Comment	Response 1	Verra comment 1	Response 2
		o indirect land use change will be minimal because of the low productivity of degraded land; o the biochar produced from the biomass can itself be used to remediate thedegraded land;			
42 (7)	Applicability Conditions	Additives (e.g., lime, bentonite, rock powder, clay or soil) are restricted to 10%. Is there an objective reason for this restriction? Higher rates could be beneficial for the pyrolysis process and / or the biochar properties (e.g., Frances et al., 2018).	The restriction is due to the GHG impact that the additives could have in the net GHG balance. Also to secure the use of the emission factors.		
42 (8)	References	Camps-Arbestain et al., 2015 is cited on pg. 20 but not listed in the references. If the reference is to the book chapter "A biochar classification system and associated test methods" it is in-deed irrelevant because it simply reproduces the information from Budai et al. (2013).	Reference section has been revised and the author has been added		
42 (9)	Quantification of GHG Emission Reductions and Removals	The column "Values for FCP" (Table 5, pg. 25) should include single values and not an interval – to be consistent with the FCP value of 0.56 for low technology facilities (pg. 24) it would be 0.19 for biochar produced from animal manure by pyrolysis (the lower 95% confidence limit), for example. (It would have been better and consistent with the PRDE value to use the lower 95% prediction limit, a small but important difference, but this value is not supplied in the reference.)	The table has been updated to show single values following a conservative approach		
43 (1)	Quantification of GHG Emission Reductions and Removals	The decay rate is set to 0.3% per annum according to the IPCC. This might be correct for the first years and in case of not fully cabonized biochars. For biochars with a H/C ration <0,7 (not<0.4) and high pyrolysis temperatures over 600°C,	The H:Corg value has been corrected as H:Corg<0.7. The 0.3% per annum is appropriate (per the IPCC and the EBC).		

#	Section	Comment	Response 1	Verra comment 1	Response 2
		we suggest to use a value of .89 after 100 years. For temperatures between 450 and 600°C and pyrolysis time over 5 minutes, we suggest to use the factor .80. Please find the relation of H/C O/C and permanence here: https://www.researchgate.net/publication/344413546_Feedstock_choice_pyrolysis_temperature_and_type_influence_biochar_characteristics_a_comprehensive_metadata_analysis_review			
43 (2)	General (Double counting)	There exists a risk of double accounting if customers are able to certify an emission reduction AND the creation of carbon sinks of the same C atoms.	This methodology considers the application of biochar as the main project activity. Therefore no risk of double counting exists between the production and application of the biochar. However, if the same C atom would be credited under this methodology and subsequently flagged as increased SOC (i.e. under VM0042), this would relate to double counting. Therefore the stacking of methodologies within the same area must be carefully implemented according to the *VCS Standard v 4.1*.	Also could point out that in the revised methodology the ability to quantify baseline emission reductions has been removed. I think that's more what the commenter is stating	This methodology considers the application of biochar as the main project activity. Therefore no risk of double counting exists between the production and application of the biochar. However, if the same C atom would be credited under this methodology and subsequently flagged as increased SOC (i.e. under VM0042), this would relate to double counting. Therefore the stacking of methodologies within the same area must be carefully implemented according to the *VCS Standard v 4.1*. Further, the methodology has been revised to exclude any avoided emissions from feedstocks in the baseline.The default baseline emission avoidance scenario for the project activity feedstock is zero (a conservative assumption). No avoidance emission are considered.

#	Section	Comment	Response 1	Verra comment 1	Response 2
43 (3)	Quantification of GHG Emission Reductions and Removals	The reduction of emissions and the creation of carbon sinks are two distinct systems which should strictly be separated. This is not the case in the draft methodology. Please differentiate.	Verra's registry does not differentiate between emission avoidance/reduction with GHG removals. If a project wants only sinks, *i.e.,* removals only, the project can and should use conservative baseline scenario of not accounting emissions avoidance. In the future, if Verra differentiates between credit types on the Registry, a revision can be made to differentiate between emissions reduction and removals	This response should be updated since the methodology has been amended to exclude any avoided emissions from feedstocks in the baseline. The result is that in this proposed version all VCUs issued will effectively be removals and could theoretically be marketed as such	Verra's registry does not differentiate between emission avoidance/reduction with GHG removals. The methodology has been revised to exclude any avoided emissions from feedstocks in the baseline.The default baseline emission avoidance scenario for the project activity feedstock is zero (a conservative assumption). No avoidance emission are considered. The result is that in this proposed version all VCUs issued will effectively be removals and could theoretically be marketed as such.
43 (4)	Applicability Conditions	Sewage sludge is supposed to be part of the eligible feedstock. In the document, we don't see it being specifically mentioned.	Table 3 has been revised. Biosolids have been added.		
43 (5)	Definitions	The term "waste biomass" is politically difficult, we are generally talking about residues. The latter do not necessarily have to be waste	Please refer to comment 8.4		
43 (6)	General (International standards)	The produced biochar must comply to standards such as IBI, EBC or national regulations. We are convinced that national regulations do not necessarily provide sufficient prevention of potential risks and would like to see all biochar comply to international standards like IBI or EBC.	The section has been revised. The project proponent shall comply with IBI or EBC, and the national regulations. The word "OR" has been deleted.		
43 (7)	Applicability Conditions	The definition of high-tech production facilities is rather weak and does not prevent the emission of potent greenhouse gases. Especially the definition of low-tech lacks precision. Different existing production technologies have to be mentioned	It is not the intention and scope of the methodology to define which technologies are approved or not. The methodology is technology agnostic and only provides a framework and guidelines for quantification aligned with the applicability conditions.		

#	Section	Comment	Response 1	Verra comment 1	Response 2
		and evaluated. Emissions of all types have to be measured as literature is, with the exception of the Kon-Tiki, where there is some evidence, practically non-existent. We suggest a positive list of technologies that will need a scientific basis, where, inter alia, possible emissions have to be determined			
43 (8)	Leakage	With regards to the loss of biochar via erosion or deflation, we see no net loss. If biochar particles are transported off the site, where the sink was created, they will be deposited elsewhere and continue to serve as a carbon sink.	If they go elsewhere, that is outside the project boundary. The methodology does not account for removals outside the project boundary. Also, sink documentation /permanence must be proven.		

9 APPENDIX 3: REFERENCES

No	Author	Title	References to the document	Provider
1.	Forliance, southpole, biochar works	Methodology for biochar utilization in soil and non-soil application	Methodology for biochar utilization in soil and non-soil application: Version 1, dated 04/08/2021 Version 1, dated 16/02/2022 Version 1, dated 22/04/2022 Version 1, dated 18/07/2022	Meth developer
2.	Cornelissen, G., Pandit, N., Taylor, P., Pandit, B., Sparrevik, M., & Schmidt, H.	Emissions and Char Quality of Flame-Curtain "Kon Tiki" Kilns for Farmer-Scale Charcoal/Biochar Production.	(2016). PLoS ONE 11(5).	Meth developer
3.	European Biochar Foundation (EBC)	European Biochar Certificate - Guidelines for a Sustainable Production of Biochar.	http://european-biochar.org. Version 10.1 from 10th Jan 2022	Website
4.	EBC	Certification of the carbon sink potential of biochar.	Retrieved from http://European-biochar.org, 2020	Website
5.	International Biochar Initiative (IBI)	Standardized Product Definition and Product Testing Guidelines for Biochar That Is Used in Soil.	IBI. (2018). Retrieved from https://www.biochar-international.org/wp-content/uploads/2018/04/IBI_Biochar_Standards_V2.1_Final.pdf	Website
6.	IBI	Guidelines on Practical Aspects of Biochar Application to Field Soil in Various Soil	IBI. (2010). Retrieved from https://biogrow.co.za/wp-content/uploads/2017/11/Biochar-Info-BI1.pdf	Website

No	Author	Title	References to the document	Provider
		Management Systems		
7.	IPCC	Appendix 4 Method for Estimating the Change in Mineral Soil Organic Carbon Stocks from Biochar Amendments: Basis for Future Methodological Development.	IPCC. (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use	Website
8.	IPCC	AR5/AR5/	IPCC Fifth Assessment Report (AR5)	IPCC website
9.	TÜV NORD JI / CDM Certification Program	CP Manual/CPM/	• TÜV NORD JI / CDM CP Manual (incl. CP procedures and forms)	TÜV NORD JI / CDM Certification Program
10.	Intergovernmental Panel on Climate Change	IPCC Guidelines/IPCC/	• 1996 IPCC Guidelines for National Greenhouse Gas Inventories: work book 2006 IPCC Guidelines for National Greenhouse Gas Inventories: work book	www.ipcc-nggip.iges.or.jp
11.	VERRA	Methodology /METH/	VCS-Methodology-Template-v4.1	VERRA
12.	VERRA	Methodology Report template/MRT/	VCS-Methodology-Report-Template-v4.0	VERRA
13.	UNFCCC	Kyoto Protocol/KP/	Kyoto Protocol (1997)	UNFCCC
14.	VERRA	Methodology Approval Process version 4.0/MAP/	Methodology Approval Process Submission version 4.0	VERRA
15.	UNFCCC	Methodological tool/TBDA/	"Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0)	UNFCCC
16.	UNFCCC	Methodological tool/TBPL/	Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)	UNFCCC

No	Author	Title	References to the document	Provider
17.	UNFCCC	Methodological tool /TCP/	"Common practice" (version 03.1)	UNFCCC
18.	UNFCCC	Methodological tool/TEF/	"Tool to calculate the emission factor for an electricity system" (version 07.0)	UNFCCC
19.	UNFCCC	Methodological tool/TIA/	"Investment analysis" (version 11.0)	UNFCCC
20.	VERRA	VCS Program Definitions/VCSPD/	VCS Program Definitions, v4.1	VCS website
21.	VERRA	VCS Program Guide/VCSPG/	VCS Program Guide, v4.1	VCS website
22.	VERRA	VCS Methodology Requirements /VCSMR/	VCS Methodology Requirements, v4.1	VCS website
23.	VERRA	VCS Standard /VCSS/	VCS Standard, v4.2	VCS website
24.	GS	Gold Standard/gs/	http://www.goldstandard.org/	Website
25.	IPCC	IPCC publications/ipcc/	www.ipcc-nggip.iges.or.jp	Website
26.	Ministry of Environmental Protection of China	Environmental Protection /mep/	http://www.zhb.gov.cn/	Website
27.	National Bureau of Statistics of China	Statistic Data/sd/	http://www.stats.gov.cn/tjsj/ndsj/	Website
28.	UNFCCC	UNFCCC/unfccc/	http://cdm.unfccc.int	Website
29.	VCS	VCS/vcs/	https://verra.org/project/vcs-program/	Website

10 APPENDIX 4: LIST OF FINDINGS

Table 1. CL from this validation

CL ID	01	**Section no.**	3	**Date:** 22/11/2021
Description of CL				
Definition of technology pyrolysis: Please clarify why specific requirements are presented for the definition of low technology pyrolysis and not "all other pyrolysis technology not meeting the conditions of high technology pyrolysis". See also sections 8.2.2.1. and 8.2.2.2.				
Project participant response				**Date:** 16/02/2022
Section 3, 8.2.2.1, and 8.2.2.2. have been modified to reflect that low technology production facilities are the ones that do not meet one or more conditions defined in high-technology production facilities.				
Documentation provided by project participant				
Updated Methodology ver. 1 dated 16/02/2022				
DOE assessment				**Date:** 09/03/2022
OK. The definition of high technology is provided under section 3 only now. Further sections 8.2.2.1 and 8.2.2.2 now define low technology as technology, which does not meet all the requirements as given for high technology. Finding closed.				

CL ID	02	**Section no.**	3	**Date:** 22/11/2021
Description of CL				
HCFA: The definition states that 1-2% of the incoming biomass will become high carbon fly ash. Hence please clarify the threshold of 5% given under applicability conditions which states that no more than 5% of the biomass facilities waste biomass stream can be used for biochar production. Please further specify the threshold of 5% as it seems all, 100% of the HFCA could be extracted for biochar production as only in max 2% of the input are HCFA and even 5% of it would be allowed to become biochar. Finally, Table 3 states under Sustainability criteria that "no more than 5% of the annual biomass throughout" is eligible for biochar. This is inconsistent with other sections, which refer to incoming biomass or waste biomass stream.				
Project participant response				**Date:** 16/02/2022
The section on "High Carbon Fly Ash" has been revised to be more consistent with the IBI standards (see Section 5.8 of the 2018 IBI standard V2.1 which can be downloaded here: https://www.biochar-international.org/wp-content/uploads/2018/04/IBI_Biochar_Standards_V2.1_Final.pdf)				
Documentation provided by project participant				
"Biomass-fueled power generating stations produce biomass ash as a byproduct of energy generation. Biomass ash—or fractions thereof, including bottom ash and flyash—may display physicochemical properties that are similar to biochar materials, including high organic carbon content" (IBI Standards V2.1, page 21). For purposes of this methodology, "bottom ash" is not eligible. Flyash with a high organic carbon content is also known as "High Carbon Fly Ash". HCFA is eligible for use if the following criteria can be met:				

1. The project proponent can meet all the requirements of the IBI Standards specifically on HCFA section 5.8;
2. The project proponent can document that they are using an affirmative technology to extract the eligible HCFA fraction which represents a change in practice of the biomass-fueled power generating station;
3. The total amount of harvested HCFA for purposes of biochar does not exceed more than 5% of the annual biomass feedstock throughput. Since HCFA is sourced from existing biomass-fueled power generating stations, if more than 5% of the feedstocks are diverted from these facilities for purposes of biochar it may begin to impact energy generation (which raises project boundary and other GHG accounting concerns).

Details on biomass ash

In the United States and Canada (in addition to some facilities in Europe), the wood products industry has biomass energy facilities to produce heat, steam, and/or energy. Some of the biomass energy is used to process wood products. For example, heat for drying lumber or steam to spin turbines for electricity generation. A certain number of these biomass-energy facilities can produce HCFA.

To illustrate the process, a figure adapted from You Lv et. al 2016 is used[38]. Biomass enters from the left and drop onto the fluidized boiler bed (see #1 in Figure 1 below). It ignites and the combustion stream travels upwards. Some of the gases and biomass enter the multi-cyclones (in the center of the image below) and are **re-circulated** back to the biomass boiler bed (see #2 below). In this set up, biomass feedstocks are being combusted twice to extract the maximum caloric value from the material. Approximately 85% of the biomass is combusted on the first pass, and 13% to 14% is consumed on the second pass.

Bottom Ash falls out threw the boiler grate during the first and second pass through the boiler (blue vessel at bottom). This bottom ash is approximately 1% to 2% of the original biomass feedstocks.

[38] You Lv, Feng Hong, Tingting Yang, Fang Fang, Jizhen Liu. 2016. A dynamic model for the bed temperature prediction of circulating fluidized bed boilers based on least squares support vector machine with real operational data. Energy Volume 125, pages 284-294. https://www.sciencedirect.com/science/article/pii/S0360544217302050

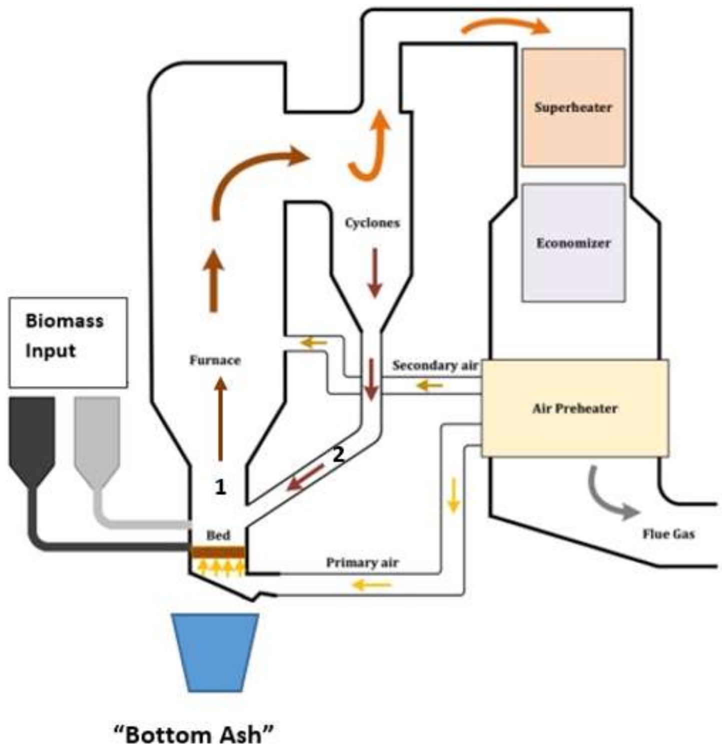

Figure 1. Illustration of a "business as usual" scenario for certain biomass co-gen energy facilities.

Qualified HCFA under the biochar methodology involves an "affirmative" technology (valve or other system labelled as "A" in the figure two below) that diverts carbonized material away from a second pass into the boiler bed and instead drops material out into a new vessel for purposes of collecting biochar (black receptacle in image below). The modification to the system involves the prevention of a second pass of the material back to the boiler bed. For purposes of the biochar methodology, the affirmative technology diversion cannot be more than 5% of the total biomass inputs on an annual basis.

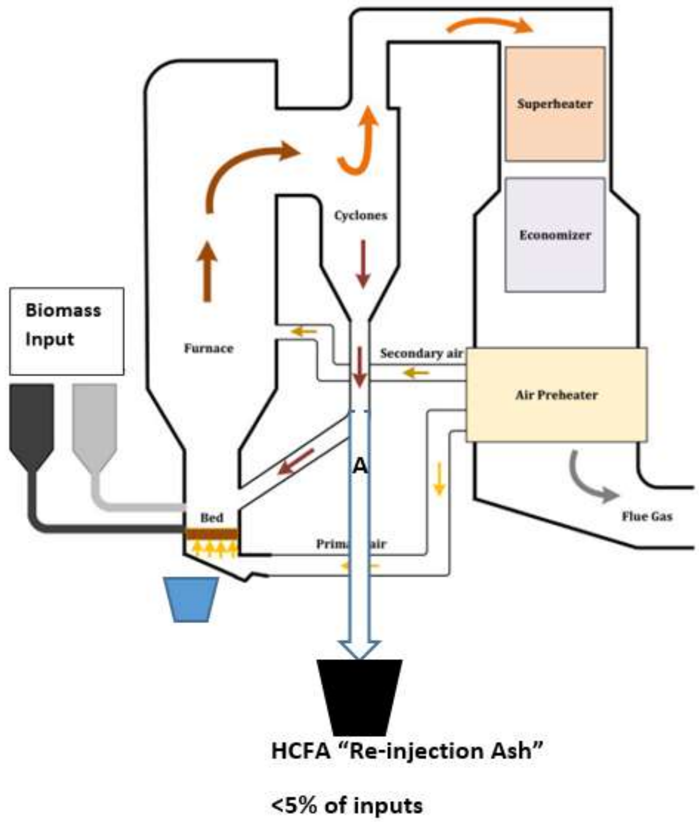

Figure 2. Illustration of a qualified biochar scenario for biomass co-gen energy facilities.

DOE assessment	**Date:** 09/03/2022
Not Ok. Related clarification has been provided. The definition of HCFA has been further specified accordingly. However, please clarify why the above stated three criteria are not specifically mentioned like this in the methodology. This would provide a clear definition of eligibility of feedstock HCFA under the methodology. E.g. the methodology states that "However, no more than 5% of the biomass facilities waste biomass stream (on an annual basis) can be used for the biochar utilized in the project activity." Taking only this sentence could be understood that it is allowed to use up-to 5% of the biomass input stream in the biomass facility for biochar production, which would reduce the input in the biomass energy generation facility. The connection to HCFA is unclear. Besides, if only 1-2% of the input biomass become HCFA how could the threshold of 5% ever exceeded? If A would be equal to "1% to 2% of incoming biomass on a dry weight basis becomes HCFA" and B equal to the "total amount of harvested HCFA for purposes of biochar does not exceed more than 5% of the annual biomass feedstock throughput" then A would be always smaller then B because 2% of input is always less than 5% of input. Or please clarify the difference between annual biomass input and annual biomass throughput.	
Project participant response	**Date:** 22/04/2022
To avoid confusion, the 1-2% has been drop out.	

Documentation provided by project participant	
Revised methodology ver 1 dated 22/04/2022	
DOE assessment	**Date:** 02/05/2022
Ok. As the reference to the 1-2% input has been deleted related clarification is provided and the threshold is clearly defined as "no more than 5% of the biomass facilities waste biomass stream (on an annual basis) can be used for the biochar utilized in the project activity". Finding is closed.	

CL ID	03	**Section no.**	4	**Date:** 22/11/2021
Description of CL				
Applicability conditions state that additives such as lime, bentonite, rock powder, or soil can be present as long as they are not more than 10% on a dry matter. Please specify not more of 10% on dry matter of the input or biochar output, besides, if the additives are added during the process or are these additives which are present in the waste due to the related nature of the waste e.g. forestry residues which contain soil remaining or agricultural waste.				
Project participant response				**Date:** 16/02/2022
Limitations on additives were modeled after the EBC Guidelines[39] (EBC Section 4.2). Additive limitations of 10% mainly center on EBC concerns about organic or inorganic contaminants as stated in EBC guidelines Section 3.8 "*Mineral additives such as rock flour and ashes, which may be used to control the quality of biochar, are subject to declaration and require written approval from the EBC if they are added in excess of 10%. If the addition exceeds 10%, the EBC may request additional quality controls with regard to organic and inorganic contaminants".* As described in section 6.3 of the EBC guidelines additives can either be added "*post-pyrolytic treatment"* or *"co-pyrolyis with oxidative or catalytically acting additives*". Following further consultation with biochar producers regarding 10% limits, we learned that additives are becoming more common in the biochar industry. Particularly for enhanced agronomic value (biochar prills mixed with additives) as well as in other applications. Given rapid development in biochar products, the current **wording in the methodology has been changed** to: *"Mineral additives such as lime, rock minerals, and flour are allowed either post-pyrolytic treatment or co-pyrolyzed. However, if the addition exceeds 10% on a dry weight basis (either post-pyrolytic or co-pyrolyzed basis as appropriate), the biochar producer must present laboratory tests indicating that the final product meets EBC or IBI thresholds for organic and inorganic contaminants."*				
Documentation provided by project participant				
Updated methodology ver 1 dated 16/02/2022				
DOE assessment				**Date:** 09/03/2022
Not ok. The methodology has been revised accordingly. However, please clarify on which basis the 10% are determined as the methodology states "However, if the addition exceeds 10% on a dry weight basis (either post-pyrolytic or co-pyrolyzed basis as appropriate) […]". It is unclear 10% on dry weight basis of which amount. Please clarify and specify if post-pyrolytic is the amount of produced biochar as well as which amount is basis for the 10% for co-pyrolysis amount, the total input feedstock amount or the biochar production amount. Further, clarification requested.				

[39] EBC Guidelines Version 9.5. https://www.european-biochar.org/media/doc/2/version_en_9_5.pdf

Project participant response	**Date:** 22/04/2022
The wording is based on the EBC standard. If the additive is added before pyrolysis the addition can not be more than 10% on a dry weight basis. If it is additive is added after pyrolysis the additive can not be more than 10% on a dry weight basis. That is what the paragraph states. The paragraph has been modified.	
Documentation provided by project participant	
Revised methodology ver 1 dated 22/04/2022	
DOE assessment	**Date:** 02/05/2022
Ok. Clarified, Either or the amount of additives is not allowed to exceed 10% of the dry weight basis of the biochar. Finding closed.	

CL ID	04	**Section no.**	4	**Date:** 22/11/2021
Description of CL				
Applicability conditions, Eligible biochar end-use application criteria: 1. Criteria 1: Please clarify the basis for this criteria and esp why biochar produced has to be utilized within one year as this is difficult to be checked during validation stage if a project start date is in the future. 2. Criteria 3: Please clarify why this is considered to be an applicability criteria and why this is not considered under monitoring section e.g. by including a parameter biochar quality and any biochar which does not meet the quality cannot be accounted for GHG emission reductions. 3. Criteria 4 requires a PP to justify that the non-soil end-use application is a long-lived and persistent application”. Pls clarify how this can be demonstrated at validation stage esp if the project start is in the future. Further, please provide a definition for the terms “long-lived” and “persistent carbon sink”. 4. Criteria 5: Pls clarify what exact criteria a project activity has to comply with.				
Project participant response				**Date:** 16/02/2022
1. Added text in criteria 1. Also added timeline for application in data and parameter monitored of Mass of biochar on dry weight basis from feedstock of type t utilized within the project activity in the end-use application k in year y. 2. Criteria 3: the project activity is the application of biochar, not the production of biochar. The methodology quantifies GHG for application of biochar. It is not the intent of the methodology to outline biochar material standard parameters or serve as guidelines for biochar production quality. The methodology relies on already established biochar material standards; therefore, the criteria was included in the applicability conditions. 3. Criteria 4: At validation stage, the project proponent can show a letter of intent (LoI) from the biochar end user where it states that biochar will be incorporated into non-soil applications. Also, the project proponent can demonstrate carbon persistent via peer review papers that the biochar production for non-soil applications. - A product life cycle is the number of years until the product has gone out of use. Long-lived products refer to products where the PP can prove that the average life is the average number of years a product is in use, and that there is peer-review literature. - Persistent carbon sink refers to the carbon content persistent on the biochar after its final application that remains after 100 years. 4. Criteria 5: the sentence has been deleted as it is mentioned in the PR factor in section 8.2.2.1.				
Documentation provided by project participant				
Revised methodology ver 1 dated 16/02/2022				
DOE assessment				**Date:** 09/03/2022
1. Ok. Related clarification is provided and methodology has been specified. The monitoring section 9.3 provides further specified requirements such as				

For soil application, monitoring requires that all projects with soil end use specify where the biochar has been applied. To ensure that biochar would be applied either in soil or non-soil applications, project developer must verify that the application takes place using for example: ● Tracking records, mobile or desk application, QR code, blockchain technology, NFT (non-fungible token), GPS use-location coordinates, and any other tracking software that allows for chain of custody record generation from the sourcing stage (i.e., waste biomass origination) to the end-use application of biochar in soils. 2. Ok, related clarification has been provided. Biochar produced has to meet IBI or EBC quality criteria. 3. Ok. any project developer could provide related documents on the intention of use of the produced biochar. Further, this could be crosschecked via monitoring parameters PRde,k, Mt,k,p,y and Mt,p,y which also require specification of amounts to application. 4. Ok as the criterion has been deleted. As all outstanding issues are resolved this finding is closed.

CL ID	05	**Section no.**	4	**Date:** 22/11/2021
Description of CL				
Issues on Table 3: 1. Please clarify whether the sustainability criteria mentioned justifying that no reduction in carbon soil amount is appearing due to the use of agricultural waste is required to be demonstrated for any agricultural waste type. 2. Please clarify how a PP could demonstrate that any wood waste would not have commercial value. 3. Please provide specific source for definition of “overstocked forest” as per footnote 9.				
Project participant response				**Date:** 09/03/2022
1. The sustainability criteria only applies to primary agricultural waste biomass. For example, if a corn farmer is using the stalks of the plant for biochar production, then the sustainability criteria applies. This is mentioned in the Table by the statement of “agricultural waste biomass directly from fields”. If instead a biochar producer sources waste agricultural biomass from a food processing facility no proof of soil carbon impact is required. For example, if a food processing facility strips the corn and has corn cobs left over as a waste product that can be used by a biochar producer without consideration of soil carbon impacts. The reason for this is “secondary” waste biomass (like from food processors or sawmills in the case of forestry biomass waste) cannot be linked to a specific parcel of land or farm location. 2. The wording in Table 3 on “no commercial value” has been removed. 3. The source and definition of overstocked has been added in the methodology. The source of the definition is Helms, J.A., editor. 1998. The Dictionary of Forestry. Society of American Foresters, Bethesda, MD. National Research Council. 2000. Environmental Issues in Pacific Northwest Forest Management. National Academy Press, Washington, DC. The specific definition of “over-stocking” is: The condition of having so many stems for a species and size that severe competition for growth resources has reduced growth, stressed trees, and put them at risk for insect, disease, or wildfire mortality. The Helms definition can be found in either the above book The Dictionary of Forestry (by the Society of American Foresters). Since the book is only available in hard copy, the definition can also be found on the following web site from the US Forest Service				

(see page B-43). https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_028660.pdf
Documentation provided by project participant
Revised methodology ver 1 dated 16/02/2022
DOE assessment — **Date:** 09/03/2022
1. Ok. Related clarification is provided. 2. Ok as related description has been deleted. 3. OK. The definition including the source of "overstocked" has been added to the definitions section 3 of the methodology. As all outstanding issues have been resolved, this finding is closed.

CL ID	06	**Section no.**	5	**Date:** 22/11/2021
Description of CL				
Please clarify the following issues w.r.t. Figure 1 in section 5: 1. Under waste biomass sourcing no reference is made to Food and HCFA. Pls clarify 2. Under application, it is referred to soil application and materials. Pls clarify why no reference to "non-soil" applications is made in line with other sections.				
Project participant response				**Date:** 16/02/2022
1. Figure 1 has been modified. Food and HCFA was included under sourcing stage 2. Non-soil application was included under application stage.				
Documentation provided by project participant				
Revised methodology ver 1 dated 16/02/2022				
DOE assessment				**Date:** 10/03/2022
1. Ok. Figure 1 refers now also to HCFA. 2. Ok. Figure 1 now also refers to non-soil application at the final application stage. As all outstanding issues have been resolved, this finding is closed.				

CL ID	07	**Section no.**	6	**Date:** 29/11/2021
Description of CL				
The section 6 refers twice to the following "As per the eligibility criteria, the waste biomass can only have two fates: decay (aerobic or anaerobic) or combustion of biomass for purposes other than energy production". Pls clarify. Further, it is stated that the PP "must provide credible evidence of the eligibility of waste biomass. Etc." Please clarify the statement as the same is already required not to be demonstrated under section 4 applicability criteria.				
Project participant response				**Date:** 16/02/2022
1. Initial sentence has been deleted. 2. The section 4 is about demonstrating sustainability sourcing of the waste biomass. Section 6 is about proving the baseline scenario of the waste biomass that could be left to decay or combusted for purposes other than energy production, that is not related to the sustainability criteria. The sentences has been modified to show this.				
Documentation provided by project participant				
Revised methodology ver 1 dated 16/02/2022				
DOE assessment				**Date:** 10/03/2022
1. Ok. The text, which has been provided twice has been removed. 2. Ok. The methodology has been revised to clarify the issue and specifies that this is w.r.t. the baseline scenario of the waste biomass. As all outstanding issues have been resolved, this finding is closed.				

CL ID	08	Section no.	7	Date: 22/11/2021
Description of CL				
Clarification is requested w.r.t. the statement "if the project activity has been commercially available in any area of the applicable geographic scope for less than three years, it shall be demonstrated that the project activity faces barriers to its uptake" in accordance with Step 3 of related CDM Tool. Pls clarify the meaning commercially available w.r.t. the project activity as the project activity is to be implemented and how could this be already available or does this refer to the related technology/measure to be implemented. Further, please specify the area of the applicable geographical scope. Does this refer to the host country or any region therein. Finally, pls clarify if the maximum penetration rate is not reached yet and the technology is commercially available any project has to demonstrate additionality in accordance with CDM tool step 3 barrier analysis.				
Project participant response				**Date:** 16/02/2022
The intent of the requirement to conduct a barrier analysis for early stage (defined as <3yrs commercially available) technologies is to catch (exclude) new technologies that are superior to what came before and will accelerate up the adoption "S" curve without needing any help from the carbon markets. Also, a brand new technology will by definition have a low penetration level (i.e., 0%) and Verra cannot credit every single new technology just because it's new. 1. The project activity is the conversion of waste biomass into biochar. So the analysis should look at the time period over which biochar made from waste biomass is available for commercial purchase in the project region (see next point) - text added clarifying this requirement into Section 7 and Appendix 1. 2. The geographic scope for determining commercial availability shall be conducted at the national level - text added clarifying this requirement into Section 7 and Appendix 1. 3. No, if the project activity is deemed commercially available for 3 or more years within the national jurisdiction, there is no requirement to conduct a barrier analysis. The project activity is automatically deemed additional if it can demonstrate regulatory surplus and meets the positive list (steps 1 and 2).				
Documentation provided by project participant				
Revised methodology ver 1 dated 16/02/2022				
DOE assessment				**Date:** 10/03/2022
1. Ok. The methodology has been specified accordingly. 2. Ok. The methodology has been specified accordingly and shall be conducted on national level. 3. Ok. It is understood that any project activity has to demonstrate additionality applying Step 1 and Step 2 as per section 7 of the methodology. Additionally, in host countries in which the project activity is commercially available for less than three years Step 3 of the CDM Tool has to be conducted. As all outstanding issues have been resolved, this finding is closed.				

CL ID	09	Section no.	8.2	Date: 29/11/2021
Description of CL				
Issues on GHG Accounting section 8: 1. Under 8.2.1 "GHG baseline emissions at the sourcing stage", it is stated "CDM Annex 18 on definition of biomass". Please clarify if this is CDM EB 28 report Annex 18 as stated in Table 3. 2. 8.2.2 description states that "Equation (3) refers to the difference between the carbon content in the biochar and the project emissions […]" Pls clarify if the reference should be equation (2). 3. 8.2.2: Equation (2). Pls clarify why for equation (1) and (13) PE are summed up and added whereas in equation (2) PE is subtracted.				

<table>
<tr><td colspan="2">4. 8.2.2.1: pls clarify why is the technology definition is in detail provided as a related definition is given under section 3 of the methodology. Please clarify how the 70% was derived, any related source? Besides, it is stated that Pollution controls such as a thermal oxidizer or other emissions controls have to be present and meet local, national or int. emission thresholds. Would a thermal oxidizer be sufficient or have all emission thresholds to be met no matter what equipment is installed. Besides, controlling emissions would not mean that thresholds are met. Does the technology have to meet certain dust emissions thresholds? Is there a hierarchy of laws/regulations to be met, first local, then national then int. or have e.g. local and nationals anyway to be met -> project activity to show related operation license and EIA approval? What happens if during emergency or shut down, repair, maintenance the emission thresholds cannot be met? Is the project activity entirely or the related entire monitoring period not eligible?
5. 8.2.2.1: Step 1: Reference is made to CDM tool 13 along with a footnote providing the direct link to the tool. This is much appreciated, however, in general to all references, if a reference, tool, source, methodology referred to is becoming invalid as a later version is available please clarify which version is then applicable under this methodology. The latest version thereof or the version to which exactly is referred to.
6. 8.2.2.1 Step 1: Table 5 Please clarify the deductions and the exact source of IPCC, which Volume Chapter and table therein is unclear. E.g. 0.89-13% = 0.7743 whereas 0.78 is stated. Further, clarify why not the value to be applied is given but additionally the background equation. See also 9.1 parameter PRde. VM0042 states under section 9 “Where discretion exists in the selection of a value for a parameter, the principle of conservativeness must be applied (as described in Section 2.2.1 of the VCS Standard, v4.0)”.
7. 8.2.2.2: Please clarify why related definition of low technology is given and not stated that all technologies which do not fulfill the criteria of high technology are to be considered low technology.</td></tr>
<tr><td>Project participant response</td><td>Date: 16/02/2022</td></tr>
<tr><td colspan="2">1. Text has been aligned throughout the document to “CDM Annex 18”
2. Rephrased wording to match formula
3. Equations have been revised.
4. It is not part of the methodology to outline what happens if there is a law violation. If the auditor finds that the project proponent was out of compliance with a law (violation of the air permit) then Verra decides what to do.
Following amendments were made
a. Provided reference to EBC standard justifying 70% of energy utilization (footnote at section 3)
b. Response hierarchy updated in footnote in Section 3. Strictest regulations apply.
5. Clarification response from Verra as the standard body. The project proponent shall use the tool that it is referenced in the original methodology. Continuous revision by the standard and standard rules will ensure the use of valid tools / methodologies.
6. As discussed, IPCC values include two digits, hence two digits seem accurate. Values have been corrected, reference to IPCC table added, decision on average values as discussed with Verra has been used.
7. Definition removed with reference to high production facilities (negative delineation)</td></tr>
<tr><td colspan="2">Documentation provided by project participant</td></tr>
<tr><td colspan="2">Revised methodology ver 1 dated 16/02/2022</td></tr>
<tr><td>DOE assessment</td><td>Date: 14/03/2022</td></tr>
<tr><td colspan="2">1. Not ok. Related revision has been conducted to the methodology, however under section 1 Sources it is referred to CDM EB 28 Annex 18 and it is not linked to the reference CDM Annex 18. Further clarification requested.
2. Ok. Methodology revised accordingly.</td></tr>
</table>

3. Ok. Methodology revised accordingly. PE has been considered correctly now in related equations. 4. OK. a. Ok. The methodology has been revised and definition of high technology and low technology is now provided in section 3 and other section refer to those. Further, definition of high technology as per section 3 provides now footnote to EBC standard which requires that excess heat must be used to at least 70%. Hence, the threshold of 70% heat use is supported with document. b. Ok. Clarified vide footnote 2 which requires the application of the strictest rules among local, national or international emission thresholds. 5. Ok. Related clarification is provided. 6. Ok. Reference to IPCC 2019 Volume 4, chapter 02 Table 4AP.2 is now made. The values have been corrected to the average values given in the IPCC reference and are consistent in revised methodology with the stated source. 7. Ok. Section revised and under high technology definition in section it is now stated if any of the high technology criteria is not met it is to be considered low technology.	
Project participant response	**Date:** 22/04/2022
1. The methodology has been revised and has been standardized. CDM Annex 18 is the final reference used.	
Documentation provided by project participant	
Revised methodology ver 1 dated 22/04/2022	
DOE assessment	**Date:** 02/05/2022
1. Ok. Related revision has been conducted. The methodology is now clear. As all outstanding issues are resolved this finding is closed.	

CL ID	10	**Section no.**	8 and 9.2	**Date:** 22/11/2021
Description of CL				
Several parameters are given with abbreviation for the corresponding year y e.g. $ER_{PS,y}$. However. Please clarify why this is not conducted throughout all parameters which are monitored or calculated on yearly basis such as the parameter M_{tl}, presented as e.g. $M_{tl,y}$ or PE_{PS} as $PE_{PS,y}$, $M_{x,t}$ as $M_{x,t,y}$, etc.				
Project participant response				**Date:** 16/02/2022
Amended the respective parameters				
Documentation provided by project participant				
Revised methodology ver 1 dated 16/02/2022				
DOE assessment				**Date:** 14/03/2022
Ok. The methodology has been corrected accordingly and parameters which are determined on annual basis are indicated with “y” now. Finding is closed.				

CL ID	11	**Section no.**	9.1	**Date:** 30/11/2021
Description of CL				
1. Parameter PR_{de}: Please clarify whether the stated default value for low technology is of upper or lower range or average as per related source. 2. Please clarify why parameter GWP_{CH4} is not provided under section 9.1.				
Project participant response				**Date:** 16/02/2022
1. Average value has been used as agreed with the standard. 2. Added to 9.1				
Documentation provided by project participant				
Revised methodology ver 1 dated 16/02/2022				
DOE assessment				**Date:** 14/03/2022
1. Ok. The average value is stated and to be applied as per VERRA.				

2. Not Ok. Parameter GWP_{CH4} is now provided in the revised methodology as ex-ante fixed parameter. However, under data unit it is stated "Dimensionless". Please clarify the statement as it is intended that GWP_{CH4} has the units "t_{CO2e}/t_{CH4}".	
Project participant response	**Date:** 22/04/2022
2.According to the latest VCS Standard https://verra.org/wp-content/uploads/2022/02/VCS-Standard_v4.2.pdf , section 3.14.4; GWP needs to be defined at standard level and not methodology, therefore, the parameter in section 9.1 has been deleted.	
Documentation provided by project participant	
Revised methodology ver 1 dated 22/04/2022	
DOE assessment	**Date:** 02/05/2022
2. OK. Related clarification has been provided. It is not included in 9.1 as GWP_{CH4} is a general default conversion factor and in line with 3.14.4. is defined at standard level. As all outstanding issues are resolved, this finding is closed.	

CL ID	12	**Section no.**	9.2	**Date:** 30/11/2021
Description of CL				
Following issues w.r.t. section 9.2 have been identified: 1. Please specify how the parameter $M_{tl,y}$, "Mass of lost biochar of type t in the year y", has to be actually monitored. It is considered that this is the difference between two monitored mass values, which are not $M_{x,t}$ and $M_{y,t}$, at different time or location and related section on description of measurement method is given with "N/A". Further, how can lost biochar be monitored esp. on dry weight basis. Pls clarify. 2. For several parameters, the dry weight basis is required. Please clarify how this is determined considering that no parameter for moisture content is given under data and parameters monitored.				
Project participant response				**Date:** 16/02/2022
Additional references on dry weight determination were added to the methodology per the IBI Standards for Testing[40] of biochar. IBI uses ASTM D1762-84 Standard Test Method for Chemical Analysis of Wood Charcoal to determine dry weight of biochar products (see Table 1, page 13 of the IBI Standards). The EBC uses DIN 51718 method A, which involves a two step process: raw moisture determined by heating at 40 ± 2) ° C until constant mass; step two hygroscopic moisture in a crucible and nitrogen atmosphere at (106 ± 2) ° C to constant mass[41]. In cases where moisture content of feedstocks is required, ASTM D4442 can be used as a guide[42]. The method involves drying samples to a constant weight in a ventilated oven at 102 to 105 ° C. The IPCC defines[43] Dry Matter as "biomass that has been dried to an oven-dry state, often at 70ºC." The wording has been updated in Section 3.				

[40] Standardized Product Definition and Product Testing Guidelines for Biochar That Is Used in Soil-Version 2.1. https://www.biochar-international.org/wp-content/uploads/2018/04/IBI_Biochar_Standards_V2.1_Final.pdf

[41] EBC and IBI testing comparison. https://www.biochar-international.org/wp-content/uploads/2018/04/IBI-EBC_comparison_Oct2014.pdf

[42] Methods of Moisture Content Measurement in the Lumber and Furniture Industries. NC Wood Products Extension. https://research.cnr.ncsu.edu/blogs/wpe/publications/methods-of-moisture-content-measurement-in-the-lumber-and-furniture-industries/

[43] IPCC Good Practice Guidance for LULUCF. Annex A Glossary. https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Glossary_Acronyms_BasicInfo/Glossary.pdf

Documentation provided by project participant	
Revised methodology ver 1 dated 16/02/2022	
DOE assessment	**Date:** 14/03/2022
1. Ok. Approach changed to mass of utilized biochar is accounted. Hence, lost biochar amount is not required any longer. 2. Ok. Under section 3 definition on dry weight is specified with related references. Finding closed	

CL ID	13	Section no.	9.3	Date: 22/11/2021
Description of CL				
Following issues w.r.t. section 9.3 Description of Monitoring Plan have been identified or have to be clarified: 1. Please clarify the meaning that monitored parameters are collected and recorded at the project boundaries. It is considered that data is collect and monitored at different locations e.g. at farmer level and via weighing scale at the biochar production facility, etc. 2. The section only requires the PP to prep a monitoring plan for the parameters given in section 9.2. please clarify if this is sufficient for example as further tools may be applied but monitoring parameters from the tools are not provided in 9.2 of the methodology as well as later in this para it is stated that the PP "[…] must be able to demonstrate the biochar application for which it is claiming emission removals." whereas no related monitoring parameter is given in 9.2. 3. As per section 9.3 the monitoring plan requires the "Project proponents must include sufficient data capture such that the mass and energy balance may be easily performed and tracked". Please clarify, why NCV is no monitoring parameter as a PP has to provide an energy balance. 4. Please clarify why no related monitoring parameter for biochar application/end-use is established in section 9.2 whereas the PP "must provide detailed biochar application records" as per 9.3. 5. Para before Box 1 states that PP must detail procedures for all data and parameters listed in Section 9. Please clarify if this refers to section 9.1, 9.2 or includes all of section 9 as in first para it is stated only those stated in 9.2 have to be monitored. 6. The methodology requires a PP to prep a monitoring plan with minimum content: a. Pls clarify why the definition of the project boundary is part of the monitoring plan as this is given in the related PD, further also the technology implemented and the emissions associated with the project activity are the result of the monitoring parameters as required by the related monitoring report. b. It is also required to monitor the amount of waste biomass pyrolyzed per year. Please clarify why no related monitoring parameter is established in section 9.2. e.g. see other related methodologies such as VM0042 7. The QA/QC plan/procedure require a PP to crosscheck values and "where necessary, correct anomalous values". Pls clarify why anomalous values have to be corrected and not the reason for anomalous values has to be identified to discuss further potential actions as not in any case anomalous values are incorrect. 8. Finally, please clarify if any back-up of digital data is required.				
Project participant response				**Date:** 16/02/2022
1. Text has been deleted and the paragraph has been modified 2. Text has been modified and a monitoring parameter has been added to Section 9.2 3. Any Energy related use through fossil or energy will be monitored through provisions of CDM tool 03 and 05. Data and paramter for waste heat fraction utilized added to the data and monitoring parameters. 4. Parameter added 5. Text modified				

6. A) Text corrected B) Parameter added 7. Text modified 8. Back up data is required.

Documentation provided by project participant	
Revised methodology version 1 dated 16/02/2022	
DOE assessment	**Date:** 14/03/2022
1. Ok. Related sentence has been removed and additional description has been provided to provide more clarity on monitoring. 2. Ok. Related description is removed and additional parameter “Biomass categories and quantities used for the selection of the baseline scenario and production of biochar utilized in the project activity” has been included in section 9.2 of methodology. 3. OK. related description is deleted and the provisions of the corresponding CDM tools apply as per related section for determining project emissions. 4. Ok. Which parameter has been added is unclear? All refer to production, none to application. 5. OK. Sentence has been deleted and hence, clarified. 6. Methodology has been revised: a. Ok. The related requirements have been removed as covered and requested by other sections of the methodology . b. Ok. Parameter “Biomass categories and quantities used for the selection of the baseline scenario and production of biochar utilized in the project activity” has been included in revised methodology. 7. Ok. Description revised, reference to anomalous deleted and added that all values have to be monitored properly. 8. Ok. As per description on Box 1 “The project proponent must have an offsite electronic back-up of all logged data. As all outstanding issues have been resolved, this finding is closed.	

CL ID	14	**Section no.**	Appendix 1	**Date:** 22/11/2021
Description of CL				
Following issues w.r.t. Appendix 1 have been identified: 1. Please clarify why under subtitle for “Global APy for forestry and agricultural residues ”the values and final result of the value MAPy is provided. It seems the section belongs also to the previous section subtitled “Maximum adoption potential (MAPy) of the project activity in year y. 2. Please clarify why the result for global APy is calculated under subtitle “Observed adoption of the project activity in year y (OAy).				
Project participant response				**Date:** 16/02/2022
<u>Regarding point 1,</u> the subtitle “Global APy for forestry and agricultural residues” has been deleted to make it clear that the section is part of the MAPy description. <u>Regarding point 2,</u> the subtitle “Global APy calculation for biochar” has been added to make it distinctive from the earlier OAy calculation.				
Documentation provided by project participant				
Revised methodology version 1 dated 16/02/2022				
DOE assessment				**Date:** 21/03/2022
1. Ok. Methodology has been revised accordingly. 2. Ok. Methodology has been revised accordingly. All outstanding issue have been closed. Hence, this finding is closed.				

Table 2. CAR from this validation

CAR ID	01	**Section no.**	8	**Date:** 29/11/2021
Description of CAR				
Please crosscheck all equations and parameter description w.r.t. conversion factor applied of 44/12, see e.g. equation (2), (15)				
Project participant response				**Date:** 16/02/2022
Equation were crosschecked and updated using the Word Function Equation				
Documentation provided by project participant				
Revised methodology version 1 dated 16/02/2022				
DOE assessment				**Date:** 21/03/2022
OK. The related equations have been revised accordingly. The conversion factor 44/12 is now clearly visible. Finding closed.				

CAR ID	02	**Section no.**	8.3	**Date:** 29/11/2021
Description of CAR				
Equation (15) considers the term $PE_{PS,y}$. which is defined as “Emissions due to production of the amount of biochar lost in the year y”. 1. Please clarify why project emissions indication “PE” is considered for leakage calculation 2. The same parameter abbreviation is used in section 8.2.2.1 and 8.2.2.2, under Step2, equation (4) and (8) to account for “project emissions at the production stage in year y”. Please correct the double usage of parameter abbreviation. 3. Further, it is unclear how the emissions due to production of the amount of biochar lost is determined/calculated.				
Project participant response				**Date:** 16/02/2022
Not required anymore as project activity is now application specific rather than production specific				
Documentation provided by project participant				
Revised methodology version 1 dated 16/02/2022				
DOE assessment				**Date:** 21/03/2022
The methodology has been revised. The project emissions are considered under related section 8 and are not required to be provided under final equation (15) as already included in stated parameters: $ER_{SS,y} + ER_{PS,y} - ER_{AS,y}$. However, equation (2) refers to parameter $PE_{PS,t,p,y}$ “Project emissions at production stage for production of biochar type t at the production facility p in the project scenario in year y (tCO2e)” whereas equations (4) and (8) refer to parameter PEPS,p,y “Project emissions at the production stage at the production facility p in year y (tCO2e)”. Pls clarify the inconsistency.				
Project participant response				**Date:** 22/04/2022
The referenced parameter in (4) and (8) have been revised by adding qualifier *t*				
Documentation provided by project participant				
Revised methodology ver 1 dated 22/04/2022				
DOE assessment				**Date:** 02/05/2022
Ok. The parameter and parameter description are now consistent. As all outstanding issues have been resolved, this finding is closed.				

CAR ID	03	**Section no.**	8.2.2.2	**Date:** 29/11/2021
Description of CAR				
Section 8.2.2.2 Table 6: 1. Please clarify the values stated as one result is presented whereas the equation refers to ±.				

2. Considering the lower range the stated values would not be correct e.g. 0.38-49% = 0.1938 or 0.77-42% = 0.4466 etc. 3. Please clarify also the exact source of the values next to IPCC 2019 also volume and chapter and e.g. related table therein. Please also check throughout the document in other sections.				
Project participant response				**Date:** 16/02/2022
1. In alignment with Verra's request, all default values refer to the average, no uncertainty deduction was considered necessary. The tables were corrected respectively 2. Source added in description, IPCC volume included in references, original table title added in doc				
Documentation provided by project participant				
Revised methodology version 1 dated 16/02/2022				
DOE assessment				**Date:** 22/03/2022
1. Ok. Methodology has been revised accordingly and only the average value is presented and in line with VERRA to be applied. 2. Ok. See point 1, only the average values are to be applied. Hence, no upper or lower range calculation required any longer. 3. Ok. The methodology has been specified accordingly. The table is from IPCC 2019 Table 4AP.1 from Volume 4 Chapter2. Finding closed.				

CAR ID	04	**Section no.**	9.1	**Date:** 30/11/2021
Description of CAR				
Following issues w.r.t. parameter Fe in 9.1 have been identified: 1. Please clarify why under value applied units, "0.09 t CH_4/t biochar", are provided as for unit there is a separate cell "data unit". 2. The stated unit under value applied is inconsistent with the unit provided in the related cell "data unit", which refers to tCO2. 3. It is unclear from the methodology description how tCO2 is determined from a value with unit tCH4/t biochar. Under description below eq. (10) further guideline is given but not in 9.1. Pls clarify. 4. Please clarify why the unit is given as tCO2 whereas under description it is referred to "from producing one tonne". Why is the unit not given as tCO2/tbiochar similar to the description below eq. (10). 5. The description in section 9.1 is inconsistent with the parameter description as provided under eq. (10) which states "Average emissions from producing one tonne of biochar in the year y". 6. Besides, the description below eq. (10) provides additional possibility to propose further appropriate values whereas this could not be identified under section 9.1 source of data or justification. 7. Further, it is stated "Generally, in low technology production facilities, there is no direct measurement of emissions. However, GHG emission must be accounted for. Conservative value (higher value of GHG emissions) considered." Pls clarify which value is to be applied which is more conservative as no range of value is given under "value applied" but one value. Pls clarify which value is to be applied for high and which for low technology. 8. Besides, please specify the exact source for the value state as it could not be reproduced from the given source. 9. The provided source Cornelissen also states CO and CH4 emissions. Pls clarify how these emissions are considered. It is unclear from the methodology default value whether all GHG emissions from production of biochar are considered by the states value.				
Project participant response				**Date:** 16/02/2022

1. The value applied has been corrected. It is stated only 0.09 as requested by the template. 2. The unit has been corrected to reflect the parameter. 3. The parameter GWP CH4 has been added to guide the project developer on the methodology application. 4. The box has been updated. 5. the box has been updated. 6. text has been added under "comment" 7. Sentence has been modified 8. Source is Conerlissen et al 2016. link: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0154617 Under gas emission factor CH4= 60+- 30 (confidence level) referring to g kg-1 biochar for all feedstocks. the methodology includes the upper confidence level following a conservative approach. the resulting value is 0.09 tch4/ tbiochar. 9. Methane emissions are considered the most impact greenhouse gas from biochar production, other gases are combusted in the kiln	
Documentation provided by project participant	
Revised methodology version 1 dated 16/02/2022	
DOE assessment	**Date:** 09/03/2022
1. Ok. Methodology revised accordingly. 2. Ok. The units have been revised to "tCO2e/tonnes". 3. Not ok. Under parameter table for Fe no value is provided now. Besides, neither under description for equation (10) nor in the box for parameter Fe "Justification of choice of data or description of measurement methods and procedures applied" it is specified how the parameter is determined. Further, a new parameter "tCH4/ tonne" is introduced which makes also reference to equation (10) whereas the parameter is not stated in equation (10). It is still unclear how Fe in tCO2e / t is determined from GWP CH4 and the conversion factor (e.g. 0.09 tCh4/t). 4. Ok. The description below eq. (10) has been unified with the unit provided in section 9.1 for the related parameter. 5. Not ok. The description under eq. (10) states "Average emissions from producing one tonne of biochar in the year y (tC02e/tonnes)." whereas the parameter description in 9.1 states "Average emissions from producing one tonne of biochar in the year y for low technology production facility" hence both are not consistent. 6. Not ok. In box of parameter Fe for comment it is stated "N/A". Pls clarify. 7. Ok. The description has been deleted and justification has been updated accordingly. 8. Ok. Related value could be confirmed from stated source. 9. Ok. As CO emissions to not have a related GWP to be applied for. Hence, those emissions are not to be considered for emission reductions calculation.	
Project participant response	**Date:** 22/04/2022
3.GWP CH4 parameter has been added to provide clarity to the project developer 5. Parameter description in 9.1. has been changed to be the same as describe in the equation 6. A description on how to calculate the parameter has been added under "comment"	
Documentation provided by project participant	
Revised methodology ver 1 dated 22/04/2022	
DOE assessment	**Date:** 02/05/2022
3. OK. Under section "Comment" for parameter Fe the following is added, "Use value of GWP of CH4 as prescribed in the latest version of VCS standard to convert tCH4 to tCO2e". Hence, is is clear now how to convert from tCH4 to tCO2e. 4. Not Ok. The description is now consistent. However, the description under eq. (10) and parameter refer to "(tCO2/tonnes)" whereas under parameter in 9.1 row for data unit it is stated "tCH4/tonne". Pls clarify the inconsistency. 5. Ok. See point 3 before.	
Project participant response	**Date:** 04/05/2022

4. Description corrected	
Documentation provided by project participant	
Revised methodology ver 1 dated 22/04/2022 provided 04/05/2022	
DOE assessment	**Date:** 04/05/2022
4. Ok. The description has been corrected. Related reference to tCCO2e/tonnes in description has been deleted. As all outstanding issues have been resolved this finding is closed.	

CAR ID	05	**Section no.**	9.1	**Date:** 01/12/2021
Description of CAR				
Following issues w.r.t. Section 9.1 have been identified: 1. Parameter F_{Cp}: a. Under data unit it is stated “Dimensionless” whereas the description states per tonne. Based on that and technical knowledge of VT, the carbon content results are not dimensionless but are either presented as % or gC/g, $t_C/t_{biochar}$. Hence, related correction requested. b. Description refers to “each production type”. Please clarify to which different production types is referred to as the parameter under section 9.1 is for low technology, the one for high technology is given under section 9.2 and monitored. c. The methodology refers that the parameter is applied in equations 3 and 7 but does not reference to equation 15, which also applies this value. Pls clarify. d. Under Source of data it is stated “For low technology production facility where no laboratory determination of the organic carbon content is possible, default values from IPCC (2019) Appendix 4 “Method for Estimating the Change in Mineral Soil Organic Carbon Stocks from Biochar Amendments: Basis for Future Methodological Development”. The sentence is incomplete. Please clarify what has to be done with the default values. Besides, clarify if those are the default values as per table 6. e. Under value applied it is stated “if Fcp cannot be monitored, use table extracted from IPCC (2019)”. Pls clarify if the same source as under “Source of data” is meant and if those data are the values in table 6. 2. Parameter PRde a. The description states that this is the “Permanence adjustment factor due to decay of biochar per end-use application”. Pls clarify why the parameter is determined in accordance with the related production facility if the parameter is depending on end-use application. b. Further, the description in section 9.1 is inconsistent with the related description provided in section 8.2.2.1 Step 1 eq. (3) which states “Permanence adjustment factor due to decay of biochar (dimensionless) to be defined as per end-use application” and in section 8.2.2.2 Step 1 eq. (7) which refers to “Permanence adjustment factor due to decay of biochar (dimensionless) in soils”. Unification requested. c. Besides, sections 8.2.2.1 and 9.1 require for high technology facilities the ratio of H:Corg to be less than 0.7 whereas the monitoring section does not require analyzing hydrogen of the produced biochar. W.r.t. this please clarify if C_{org} is identical with parameter F_{Cp}.				
Project participant response				**Date:** 16/02/2022
1. a. Changed to % b. At validation stage, both production facilities can use the default values from IPCC or other peer-review literature. c. Equation 15 has been added d. Source of data information has been updated. The values has been added in “value applied” e. Source of data is equal to table 6, values has been added.				

2. a. The permanence refers to the end use application and it is related to the pyrolysis temperature used. In high - tech the temperature parameter is monitored, whether in the low tech is not. That is why the PRde is also related to the production facility b. Description has been updated. c. Corg and Fcp is the same parameter. H/Corg is defined per international standards. The parameter has been added in section 9.2	
Documentation provided by project participant	
Revised methodology version 1 dated 16/02/2022	
DOE assessment	**Date:** 09/03/2022
1. F_{Cp}: a. Ok. Related parameter unit of “%” is now provided. b. Ok. Related clarification has been provide and the methodology has been specified accordingly. c. Not ok. Response unclear as eq. (15) is deleted in revised methodology. Besides, parameter depiction in eq. (3) and (7) is given as FCp,t,p whereas section 9.1 refers to FCp only. Pls clarify the inconsistency esp. as also the description in 9.1 refers to “biochar type t produced in the production facility p”. d. Ok. Values as per Table 6 have to be applied if not monitored as now stated in methodology. Further, for high technology this parameter has to be monitored. e. Ok. Reference to table 6 is made which provides related values. 2. $PR_{de,k}$: a. Not ok. The determination of the applied value in accordance with applied technology and temperature is clarified. However the methodology states for high technology, “, project proponents must use Table 6 from IPCC (2019, Table 4AP.2)” whereas it is unclear to which table 6 is referred to as IPCC 2019 has not table 6. Pls clarify and revise accordingly. b. Ok. The descriptions have been revised to be consistent throughout the methodology. c. Ok. A related parameter H:Corg has been included in Section 9.2 of the methodology.	
Project participant response	**Date:** 22/04/2022
1c. Parameter has been standardized in section 9.1 2a. Clarification to Table 6 within the current methodology has been added.	
Documentation provided by project participant	
Revised methodology ver 1 dated 22/04/2022	
DOE assessment	**Date:** 02/05/2022
1. F_{Cp}: c. Ok. parameter depiction and descriptions are now consistent. 2. $PR_{de,k}$: a. Ok. Related clarification has been provided and methodology has been revised accordingly. As all outstanding issues have been resolved this finding is closed.	

CAR ID	06	**Section no.**	9.2	**Date:** 01/12/2021
Description of CAR				
Following issues w.r.t section 9.2 Data and parameters monitored have been identified: 1. Parameter Mx,t: a. The parameter description states “Total mass of biochar on dry weight basis produced in the production facility from feedstock of type t in the year y”. Pls clarify how the different technologies such as high and low technology facilities are considered esp. if at one production site both, low and high technology equipment, is used for the production of biochar. The same is not considered yet under ER determination and monitoring.				

b. The methodology refers to equations 5 and 10 whereas the parameter is applied in corresponding equations 4 and 8. Correction requested.

2. Parameter My,t:
   a. Under description it is stated that this is the “Mass of biochar on dry weight basis of type t applied to the respective end-use in the year y”. Pls clarify if biochar could be used for different end-use and why this is not specifically indicted e.g. “applied to the respective end-use k in the year y” and via e.g. parameter My,t,k.
   b. The parameter description is inconsistent with the description provided under eq. 8 which refers to “Mass of biochar on dry weight basis from feedstock of type t utilized within the project activity in the end-use application in year y”.
3. Parameter FCp:
   a. Under data unit it is stated “Dimensionless” whereas the description states per tonne. Based on that and technical knowledge of VT, the carbon content results are not dimensionless but are either presented as % or gC/g, $t_C/t_{biochar}$. Hence, related correction requested.
   b. Description refers to “each production type”. Please clarify.
   c. The methodology refers that the parameter is applied in equations 3 and 7 but does not reference to equation 15, which also applies this value. Update requested.
   d. Under Source of data it is stated “Laboratory
   e. The methodology states under Frequency of monitoring “annual”. Please clarify if one annual analysis is sufficient or if samples have to be taken per batch, day or month out of which a mixed sample is created which is then analyzed. Hence, please clarify if this is an annual average value determined based on a determined number of samples and certain number of analysis in a year y.
   f. Further, under “Comment” it is stated that “where a continued sampling of the organic carbon content of the biochar is not possible conservative values can be used.
      i. Pls specify the meaning of “continued sampling” in this regard.
      ii. As per other section of the methodology (pg 21 equation (3)), for high technology equipment analyses are mandatory. However, by this a PP justifying none possibility of continued sampling could apply stated conservative values.
      iii. Finally, it is stated that values in Table 6 and below are to be used. Pls clarify why stated double, reference to table 6 would suffice the need. And please clarify why this is anyway given as related parameter for low technology is given under section 9.1 of the methodology.
4. Parameter Tprod:
   a. The description states that this parameter is the “average production temperature of the pyrolysis”. However, no further specification has been given e.g. under description of measurement method whether values to determine the average include periods of start-up, shut-down, emergency or maintenance have to be considered. Besides, ACM0021 considers also a parameter “start time and end time of each carbonization cycle”.
   b. For the description of the measurement methods and procedures please clarify why e.g. related procedures as per CDM Tool 08 parameter Tt have not been considered, e.g. the use of a thermocouple, periodic calibration and if the data has to be recorded digitally.
   c. The monitoring frequency is given with “annual”. Please clarify if the temperature has to be monitored continuously and averaged annually

Project participant response	**Date:** 16/02/2022

1. a. A production facility must fall under high or low technology. As production is provided per production site, the respective M-parameters can be differentiated according to these. Therefore, no correction is required
1. b. corrected
2.a. added the end use specifier k as suggested in formulas and parameters

2.b. changed the parameter description 3.a. Changed to % 3.b. Parameter has been corrected 3.c corrected 3.d.unclear. It is assumed that the VVB questions why F_{CP} is either listed under 9.1. and 9.2. Low tech will be able to use default figures, hence parameter is available at validation. High-tech will be required to provide regular analysis reports from their biochar samples. Hence the value of FCP will be based on lab analysis. 3.e. The monitoring parameter has been updated to indicate sampling intervals aligned with the IBI standard protocol 3.f. see 3.e. added reference to the relevant standards 3.f.ii. Methodology specifies that "For low technology production facility where no laboratory determination of the organic carbon content is possible," hence no high-tech would be able to use default values. Amended the monitoring parameter entry to reflect this and removed the table, solely referencing the previous table. 3.f.iii. the project activity is application /end-use of biochar, not production of biochar. 4.a. Temperature measured at the production of biochar 4.b. The methodology focused on the application and rely on biochar production standard such as EBC/IBI for biochar properties and uses. 4.c. The parameter has been corrected.	
Documentation provided by project participant	
Revised methodology version 1 dated 16/02/2022	
DOE assessment	**Date:** 09/03/2022
1. Parameter $M_{x,t}$: a. Ok. As per definitions, section there is differentiation between high technology production facility and low technology production facility. This clarifies that the production facility is not the entire location where biochar is produced but only the technical single equipment, which is producing the biochar. Hence if at a location two production facilities of high and low technology are installed, the total mass produced by each facility has to be separately monitored and reported (Mx,t,p1 and Mx,t,p2). b. Ok. Methodology corrected accordingly. 2. Parameter $M_{y,t}$: a. Ok. Related depiction of type and application are now considered in parameter denomination. b. Ok. Descriptions are now consistent throughout the methodology. 3. Parameter FCp: a. Ok. Unit "%" is provided now. b. Ok. Parameter description has been revised accordingly and it is now clear. c. Not ok. Response unclear as eq. (15) is deleted in revised methodology. Besides, parameter depiction in eq. (3) and (7) is given as FCp,t,p whereas section 9.1 refers to FCp only. Pls clarify the inconsistency esp. as also the description in 9.1 refers to "biochar type t produced in the production facility p". d. Ok. The description provided under source of data was actually justification of measurement method. The methodology has been revised and under source of data for this parameter, it is now only referred to the actual source for the values "Laboratory material analysis". e. Ok. The frequency of monitoring has been revised based on IBI Standard, which is considered sufficient and reasonable. f. Assessment: i. Ok. Term "Continued" has been deleted and sampling has to be conducted as per required standard. ii. Ok. It is clarified that only low technology can apply default value instead of sampling.	

iii. Ok. The description under "Comments" for this parameter has been revised and refers now to Table 6 and the term "and below" has been deleted. 4. Parameter T_{prod}: a. Not ok. It is still unclear how the "average" temperature of the production facility is determined esp. in batch processing. b. Ok. Related requirements have been introduced in revised methodology. c. Ok. Monitoring frequency has been provided with continuously now. 5. Not ok. However clarify why parameter $M_{t,k,y}$ is no monitoring parameter as given in eq. (3) and (7).			
Project participant response			**Date:** 22/04/2022
3c. Parameter has been revised and standardized throughout the methodology 4a. Average annual temperature taken during the pyrolysis process. Frequency has been added: aggregated to annual averages 5.Parameter in Eq 3 has been modified to Mt,k,p,y and its respective parameter is added in the section 9.2.			
Documentation provided by project participant			
Revised methodology ver 1 dated 22/04/2022			
DOE assessment			**Date:** 02/05/2022
3. F_{Cp}: c. Ok. Methodology has been revised accordingly and parameter is now consistent throughout the methodology. 4. T_{prod}: a. Ok. Monitoring frequency and value is aggregated to an annual average value. 5. Ok. Methodology has been revised accordingly and parameters are now consistent. As all outstanding issues have been resolved this finding is closed.			

Table 3. FAR from this validation

FAR ID	xx	**Section no.**		**Date:** -
Description of FAR				
Project participant response				**Date:** -
Documentation provided by project participant				
DOE assessment				**Date:** -

The VCS review has resulted in the following issues to be addressed:

CAR ID	07	**Section no.**	2	**Date:** 31/05/2022
Description of CAR				
The methodology developer is requested to provide a clear definition of the project activity. Section 2 mentions that the project activity is the "adoption of improved Waste Handling and Disposal (WHD) practices to make biochar" and "the final utilization of biochar in soil or non-soil applications." The definition provided is broad and does not state the specific activities the project proponent must implement to use this methodology. For example, based on the structure of the methodology, it could be defined as "the project activity must consist of the sourcing of waste biomass, producing biochar from the sourced biomass and utilizing biochar in soil or non-soil				

applications." Thus, the developer is requested to provide a more robust definition of the project activity that specifies the acts the project proponent(s) must implement.	
Methodology developer response	**Date:** 29/06/2022
The project activity is now clearly defined.	
Documentation provided by project participant	
Revised methodology	
VERRA response	**Date:** 12/07/2022
Finding remains open. The developed is requested to provide a clear definition of the project activity as it is still not clearly defined. Verra has provided suggestions in Section 2 of the draft methodology that better captures the project activity. The description now reads "The project activity consists of three parts – 1) sourcing waste biomass, 2) producing biochar and 3) utilizing the biochar in soil or non-soil application." The developer may review and accept the suggestions in the draft methodology or provide a better definition.	
Methodology developer response	**Date:** 14/07/2022
The developer has accepted the suggestion of Verra regarding project activity. However, the developer also believes that it is important to clarify that only new biochar facilities are eligible (to ensure retroactivity criteria and start date criteria as well) and credits would be allocated only for the amount of biochar produced that is utilized in eligible soil and non-soil applications. An additional paragraph has been added in Section 2. This is also necessary as it would ensure any biochar lost before the end use is not taken into account for crediting.	
Documentation provided by project participant	
Revised methodology dated 18/07/2022	
VERRA response	**Date:** 19/07/2022
Findings is closed. Section 2 of the draft methodology has been updated to clarify the project activity and start date	

CAR ID	08	**Section no.**	4	**Date:** 31/05/2022
Description of CAR				
The methodology developer is requested to consolidate the applicability conditions. Section 4 of the methodology lists a total of twenty-four applicability conditions, some of which are already covered by existing rules and requirements in the VCS Standard, v4.2. Some applicability conditions are similar and can be consolidated. Furthermore, the format of the applicability conditions can be streamlined to make it easier for project proponents to demonstrate compliance and for VVBs to validate. Thus, the methodology developer is requested to do the following: 1) Remove conditions that are covered by the VCS Standard, v4.2. For example, please remove the condition that project proponents must demonstrate compliance with all applicable regulations. 2) Consolidate similar applicability conditions. For example, please consolidate all transport-related conditions under one applicability condition. The developer may employ sub-conditions. 3) Make the conditions more concise. 4) Clarify how project proponents can demonstrate compliance with applicability conditions. 5) Apply a number listing format to the conditions. 6) Restructure the flow conditions to be clear and logical. 7) Update Table 3 to clarify the sustainability criteria for each feedstock category. The methodology developer may refer to comments and tracked changes in the methodology document for more details.				
Methodology developer response				**Date:** 29/06/2022
Section 4 has been revised and updated according to the suggestions provided.				
Documentation provided by project participant				
Revised methodology				
VERRA response				**Date:** 12/07/2022

Finding remains open. The developer is requested to review the following applicability conditions and the related comments: 1. Applicability Condition #4: The developer is requested to be more concise about the eligibility conditions for feedstock. Verra has provided suggestions to the language in the draft methodology, which combines applicability conditions 4 and 5 and moves the condition for HCFA into Table 3. 2. Applicability Condition #8: The developer is requested to list the conditions for high and low technology facilities in this condition. Please see the draft methodology for Verra's suggestions. 3. Applicability Condition #12: The developer is requested to remove the following sentence "The produce must have key properties similar to or better than the product it displaces (e.g., biochar infused concrete substituting baseline concrete in construction)" as it would be difficult for the project proponent to demonstrate and the VVB to assess undefined properties of different products. The developer may accept the suggestions above.	
Methodology developer response	**Date:** 14/07/2022
1. Application condition 4: The developer accepts the suggestions from Verra 2. Condition 8: The developer has revised the wording and has accepted Verra's suggestions and the respective section was referenced and changed accordingly 3. Condition 12: The developer agrees with removing the sentence	
Documentation provided by project participant	
Revised methodology dated 18/07/2022	
VERRA response	**Date:** 19/07/2022
Finding is now closed. The methodology developer has updated Section 4 of the methodology, specifically Applicability Conditions 4, 8 and 12. The conditions are now concise and clear.	

CL ID	15	**Section no.**	4	**Date:** 31/05/2022
Description of CAR				
The methodology developer is requested to clarify how the project proponent may demonstrate that the project activity does not lead to a decrease in other carbon pools, in particular the soil organic carbon (SOC) pool. The last bullet in the Applicability Conditions states that the "methodology is not applicable if the project activity leads to a decrease in other carbon pools, in particular, soil organic carbon degradation on agricultural lands, or excessive removals of forest woody debris or litter…" Demonstrating this will be exceedingly difficult and complex as there are many biochar-SOC interactions that could lead to positive or negative priming (i.e., acceleration or slowing of soil organic matter decomposition). There is sufficient research in the scientific literature to demonstrate that biochar additions under most conditions can be expected to result in negative priming over the long term (e.g., https://onlinelibrary.wiley.com/doi/full/10.1111/gcbb.12665). Furthermore, excess removal of forest woody debris of litter would primarily happen during the feedstock sourcing stage, not as part of biochar application. Because the feedstock sustainability applicability condition for "forestry and other wood processing" already addresses degradation, it is redundant to include this carbon pool in a separate applicability condition prohibiting its degradation. Other biogenic carbon pools such as above- and belowground biomass also do not pose high risk of degradation/loss with biochar soil applications. Unless the methodology developer can propose a simple and accurate approach to demonstrating no SOC degradation, we suggest removing the last applicability condition.				
Methodology developer response				**Date:** 29/06/2022
1. The requirement referred is removed 2. To maintain consistency, other similar requirements were also reviewed. Table 3, Row 1, column 3, point b 'Feedstock removal is therefore limited to no more than 50 percent of total residues (Andrew, 2006; Battaglia et al., 2020)' is also removed. Other similar approved methodologies/tools that involve utilization of waste biomass were referred. E.g., CDM AMS III				

E, CDM AMS III BG, CDM ACM0006, CDM ACM0017, CDM Tool 16. There is no precedence of any similar requirement/criteria.	
Documentation provided by project participant	
Revised methodology	
VERRA response	**Date:** 12/07/2022
Finding remains open. 1. Verra agrees with removing the referenced text (last bullet in applicability conditions). 2. Verra does not agree with removing the safeguard around limiting agricultural residue feedstock removal to no more than 50% and has reinstated the text. In the absence of documentation demonstrating no loss of SOC stocks, projects should be restricted from removing excess residues as supported by the citations Andrew 2006 and Battaglia et al 2020. Note that whereas the listed CDM methodologies (none of which is specific to biochar production) don't have similar requirements, puro.earth's biochar methodology does have a requirement to retain minimum 30% residues in field - see clause 1.1.2. Therefore, Verra finds it important to have a similar requirement to protect against soil degradation in the event of excessive residue removal. Please refer to the suggested changes in the draft methodology. The methodology developer may review and accept these suggestions in the draft methodology. The modification ensures safeguards and also ensures appropriate utilization of waste biomass, as appropriate in the project scenario.	
Methodology developer response	**Date:** 14/07/2022
The developer agrees to the safeguard (retaining 50% of the waste biomass in alignment with the mentioned safeguard program under Puro to contribute to industry alignment) but is also cognizant of the fact that in many cases agriculture waste biomass is burned without energy production, leading to severe air quality issues. See this as an example. To ensure that waste biomass otherwise burned is still eligible and ensuring safeguards that if waste biomass was left in the field, it would have probably acted as a fertilizer, the methodology developer has modified table 3, row 1, column 2, a) and added baseline biomass burning as an exemption.	
Documentation provided by project participant	
Revised methodology dated 18/07/2022	
VERRA response	**Date:** 20/07/2022
Finding is now closed. Verra agrees with the methodology developer's exemption for agricultural waste biomass that would otherwise have been burned in the baseline.	

CAR ID	09	**Section no.**	8	**Date:** 31/05/2022
Description of CAR				
The methodology developer is requested to restructure the contents of Section 8 in accordance with the instructions of the VCS Methodology Template, v4.1. Currently, the methodology developer combines the baseline and project emissions in one section (see Section 8.2) and categorizes the quantification approaches by stages (i.e., sourcing, production, application). According to the VCS Methodology Template, v4.1, Section 8.1 should describe the criteria and procedures for baseline emissions and Section 8.2 should describe the criteria and procedures for project emissions. Therefore, the methodology developer is requested to update Section 8 so that the section contents are in line with the structure set out in VCS Methodology Template, v4.1. All equations related to net GHG emission reductions and removals for each stage of the process should be outlined in Section 8.4. Section 8.1 on "Background Information" can be left as introductory text to Section 8, without needing a sub-section heading. For stages that do not result in any baseline or project emissions, the methodology developer may include a short paragraph justifying why the emissions are not quantified.				

The methodology developer may refer to comments and tracked changes in the methodology document for more details.	
Methodology developer response	**Date:** 29/06/2022
The section has been updated accordingly to the VCS Methodology Template, v4.1.	
Documentation provided by project participant	
Revised methodology	
VERRA response	**Date:** 12/07/2022
Finding is closed. The developer has updated the draft methodology according to the template.	

CL ID	16	**Section no.**	8.2.2.1	**Date:** 31/05/2022
Description of CAR				
The methodology developer is requested to clarify the evidence requirements to support the determination of the permanence adjustment factor ($PRde,k$) for non-soil applications when the default values listed in Table 5 are not used. For example, how many scientific papers are required as evidence? Must the scientific paper(s) be from a journal indexed in the Web of Science SCI (as per the new VCS rules for default factors in the soon-to-be-released *VCS Methodology Requirements v4.2*, please see below)? Are alternative sources like industry publications or government databases permissible forms of evidence? The proposed language in *VCS Methodology Requirements, v4.2* is as below: “Where methodologies use default factors and standards to ascertain GHG emission data and any supporting data for establishing baseline scenarios and demonstrating additionality, the following applies: 1) Where the methodology uses third-party default factors and/or standards, such default factors and standards shall meet with the requirements for data set out in Section 3.4.6, *mutatis mutandis*. Where the methodology requires peer-reviewed scientific literature to establish such default factor(s) the following shall apply: a. The literature shall be in a journal indexed in the Web of Science: Science Citation Index (SCI); available at https://mjl.clarivate.com). b. Where there is no relevant literature indexed in the SCI, the project proponent may propose alternative source(s) of information (e.g., government databases, industry publications) to establish the default factor(s) and shall provide evidence that the alternative source(s) of information is robust and credible (e.g., independent expert attestation). c. Where the default factor(s) is not derived from primary data in the SCI-indexed literature or in the alternative source of information (e.g., it is established by referencing other publications, or it is a meta-analysis), the primary source(s) from which it was drawn shall be cited.” Therefore, the methodology developer is requested to clarify the evidence requirements for PRde,k, preferably in line with the language that will be published in *VCS Methodology Requirements, v4.2*.				
Methodology developer response				**Date:** 29/06/2022
Clarified that one evidence is enough. The language now refers to the above mentioned requirements of the VCS Methodology to ensure consistency with the rules and avoid establishing conflicting rules and requirements for data. The language of the requirement now also clarifies that if the different information sources propose different values, the lower value must be taken to ensure conservativeness.				
Documentation provided by project participant				
Revised methodology				
VERRA response				**Date:** 12/07/2022
Finding is closed. Verra agrees with the changes. We have further added the section of the VCS Methodology Requirements document specifying requirements around default factors. The developer may review and accept these suggestions				

CL ID	17	Section no.	8.2.2.2	Date: 31/05/2022
Description of CAR				
The methodology developer is requested to clarify how the default average emission factor for CH4 of 0.09 t CH4/tonne is derived for Fe parameter. Cornelissen et al. (2016) https://doi.org/10.1371/journal.pone.0154617 does not include a value of 0.09 for CH4 emissions. Table 3 in the paper lists CH4 emission factors for four different kiln types, all of which are less than 0.09 t CH4/tonne. The average value of these four is 32 g/kg, i.e., 0.032 t CH4/tonne.				
Methodology developer response				**Date:** 29/06/2022
The value considers the average plus the upper bound of the interval of confidence in order to ensure conservativeness. This is equal to CH4 = 30 ± 60 k kg-1.				
Documentation provided by project participant				
Revised methodology				
VERRA response				**Date:** 12/07/2022
Finding remains open. Verra believes that adding one standard deviation interval to the average CH4 emissions value for the four kiln types tested is overly conservative. We have modified the guidance for parameter Fe to indicate that values in Table 3 should be used based on kiln type and where the kiln type is unknown the value for traditional kilns should be used since these are known to emit higher levels of CH4 and can be thus conservatively used as a default. We also modified the parameter table for Fe in Section 9.1. The developer may review and accept these suggestions in the draft methodology.				
Methodology developer response				**Date:** 14/07/2022
The developer accepts the changes proposed.				
Documentation provided by project participant				
Revised methodology dated 18/07/2022				
VERRA response				**Date:** 20/07/2022
Finding is now closed. Verra in parallel reached out to the lead author on the cited paper with the Fe values, Gerard Cornelissen, who responded in the affirmative that he considers the mean values as conservative. Given this response we are confident in the conservativeness of the updated approach. Following is quoted text from his email: “The CH4 emissions are absolutely conservative estimates … The problem is that we had rather moist feedstock (about 25% humidity) and this is the reason for these significant CH4 pulses (that occurred when too much or too moist feedstock was added). The data are relevant for moist feedstock e.g. in the humid tropics (e.g. Indonesia, Bangladesh) but not for most of Africa in the dry season. I am almost sure that methane emissions will be zero if a flame curtain kiln is fed with completely dry feedstock (< 10% moisture) such as in the dry seasons in many regions of Africa. This will much improve the CO2 balance.”				

CAR ID	10	Section no.	8.4	Date: 31/05/2022
Description of CAR				
Verra has substantially edited Section 8.4 (in tracked changes) to improve readability and clarity. The methodology developer is further requested to update Section 8.4 of the methodology to: 1) Provide more guidelines on how project proponents must report losses and reversals that align with the VCS Program rules and requirements as part of Section 8.4.1 (Section 8.3.1 with edits), and 2) Ensure that project proponents are reporting losses and reversals for natural risk when biochar is utilized for non-soil application.				

While the developer describes how a project proponent deals with a reversal, there is no guidance on how project proponents must report losses. Section 3.2.15 through 3.2.17 of the *VCS Standard, v4.2* and Section 5.3 of the *Registration and Issuance Process, v4.1* document includes guidelines on how project proponents must report losses and reversals that occur in AFOLU projects. In the context of the biochar methodology, the developer is encouraged to refer to the sections above and develop reporting guidelines that are relevant to projects (i.e. non-AFOLU) using this methodology. Some of the key elements may include: 1) Submission of a loss event report and representation (see Section 5.3.1 of *Registration and Issuance Process, v4.1*), 2) The timeline to report loss events, and 3) Language that specifies adherence to any applicable loss and reversal requirements and guidelines in the latest version of the VCS Program documents. Even though the natural risks for non-soil application is minimal, the methodology developer should also require project proponents to report any losses and reversals because these events can still occur, for example in structural fires.

Methodology developer response	**Date:** 29/06/2022
1. Sub finding 1 Provide more guidelines on how project proponents must report losses and reversals that align with the VCS Program rules and requirements as part of Section 8.4.1 (Section 8.3.1 with edits), - The section is not possible/appropriate to draft as the methodology and the project type does not have any provisions for buffer, i.e., no contribution to buffer pool is being made by the project proponent at the time of issuance. - The risk of any reversal is reduced to the less than 5% through the applicability conditions and the justification provided in section 8.4 Risk of Reversal - Further, carbon content after the application (in soil/non-soil) is not measured, hence it is not would be possible to conclusively infer whether a reversal and subsequently loss event has occurred or not. - In case of non-soil application, end destination of the product is unknown. As per the methodology requirement, biochar is measured at the time of mixing with the non-soil product (e.g., mixing of biochar in the concrete). - Any loss of biochar such as combustion in the storage site or loss during transportation of biochar from point A to B, is already not counted as benefits, as the methodology only credits GHG benefits for the biochar that is utilized in eligible soil/non-soil application. **Sub finding 2** Ensure that project proponents are reporting losses and reversals for natural risk when biochar is utilized for non-soil application. - In case of use of biochar in non-soil application, the end use is established at the point where biochar is mixed with the product. E.g., amount of biochar added to the concrete mix/cement or similar use case. It is virtually impossible to track the end destination to such products. Example, biochar might be mixed with cement in the factory but be transported 100 km from the factory to be used in construction. The methodology ensures that only in places where reversal risks is minimised to below 5% is allowed through applicability conditions of the end use. The applicability states: biochar is eligible to be used in non-soil applications including but not limited to cement, asphalt, and any other applications where long-term storage of the biochar is possible. For non-soil applications, project proponents must demonstrate that biochar and/or final products are long-lived	

using peer-reviewed literature or any other third party-evaluated product assessment, such as a decay rate analysis, as applicable. The information provided must include the lifetime of the product in which biochar is stored long-term. - Another applicability condition has been added to ensure minimization of risk of reversals. "When biochar is used in non-soil application, the resultant product must have key properties similar or better than the product it displaces (e.g., biochar infused concrete substituting baseline concrete in construction). This can be demonstrated via credible evidences such as such as laboratory results, peer reviewed research papers or any third party evidence. The resultant product must be compliant with national / international product quality standards/specifications as applicable (e.g. for US - relevant American Concrete Institute Standards)" Through both these applicability conditions, the risks of reversals are minimised to the maximum possible.				
Documentation provided by project participant				
Revised methodology				
VERRA response				**Date:** 12/07/2022
Finding remains open. Verra agrees with the developer's rationale for both sub-findings. The mitigation approaches and strengthened applicability conditions render reversal risk negligible. We have updated Section 8.4 accordingly. Developer is requested to review and may accept the updated text in the draft methodology.				
Methodology developer response				**Date:** 14/07/2022
The developer accepts the proposed changes by Verra.				
Documentation provided by project participant				
Revised methodology dated 18/07/2022				
VERRA response				**Date:** 20/07/2022
Finding is now closed. The methodology developer accepted Verra's proposed changes to the risk mitigation section of the methodology.				

CAR ID	11	**Section no.**	8.5	**Date:** 31/05/2022
Description of CAR				
The methodology developer is requested to update Equation 15 so that the net GHG emission removals are a sum of all GHG emission removals across the stages subtracting the total leakage emissions. Alternatively, the methodology may remove the (-1) factor in Equation 12. Currently, Equation 15 subtracts the GHG emissions at application stage in year y (ERAS,y): However, Equation 12 demonstrates that the GHG emissions at application stage in year y (ERAS,k,y) will result in a negative value: Since Eap,k,y is zero, ERAS,k,y will equal to the project emissions at application stage in year y. Therefore, the net GHG emission removals should subtract instead of add the value of ERAS,k,y. The developer is requested to either update Equation 12 or 15 to reflect this. Even though the natural risks for non-soil application is minimal, the methodology developer should also require project proponents to report any losses and reversals because these events can still occur, for example in structural fires.				
Methodology developer response				**Date:** 29/06/2022
Change made to equation 15. Now reads: ERy =($ERSS,y - ERPS,y - ERAS,y$)$- LEy$ where removals are now being subtracted				
Documentation provided by project participant				

Revised methodology dated 18/07/2022	
VERRA response	**Date:** 12/07/2022
Finding is closed. The developer has made the appropriate changes to Equation 15.	

CAR ID	12	**Section no.**	9.3	**Date:** 31/05/2022
Description of CAR				
The methodology developer is requested to update Section 9.3 to streamline the monitoring requirements so that the requirements for each application type is clear, and to clarify the geographical information reporting requirements. Currently, the developer provides many levels of requirements and suggestions in Section 9.3, which may be difficult for the project proponent to navigate. The developer is suggested to consolidate guidelines and suggestions by category (e.g., application type, geographic information, data management, QA/QC). Additionally, the guidelines provided in Box 1 could be incorporated into the main body based on the categories. Furthermore, the methodology developer should request project proponents to provide geodetic coordinates for each instance, especially when end-use application sites are known, and it is reasonable to do so. The developer may provide a hierarchy of reporting preferences, so that project proponents will report the most accurate information when available.				
Methodology developer response				**Date:** 29/06/2022
The section has been structured based on the categories suggested.				
Documentation provided by project participant				
Revised methodology dated 18/07/2022				
VERRA response				**Date:** 12/07/2022
Finding is closed. The developer has updated Section 9.3 of the draft methodology sufficiently.				