RESPONSE TO PUBLIC COMMENTS

A methodology for *Methodology for Biochar Projects, v1.0* was developed by The Climate Trust, The Prasino Group, the International Biochar Initiative, and Carbon Consulting, and submitted to ACR for approval through the public consultation and scientific peer review process.

The methodology was formally submitted to ACR on April 22, 2013. ACR conducted its standard internal methodology screening and the authors submitted revised drafts on August 8 and September 20.

The methodology was then posted for public comment from September 26 – November 22, 2013. Public comments and responses by the authors are given below.

Following public consultation, the methodology will be submitted to three peer reviewers, experts in the fields of grassland and shrubland soil science, GHGs from crop production and GHG offset methodologies, for a blind review. Peer review comments and responses are summarized in a separate document.

General (TK)

	Comment	Commenter	Response	Changes to Methodology
0.1	Seems that cost of verification may be higher than carbon credits earned?	Jeff Schahczenski	Until the initial projects have been through the verification process, verification costs are not fully known. We are doing everything we can to streamline this methodology in order to control transaction costs, while ensuring scientifically credibility. Full costs are not yet known, but the initial reality is likely to be that only large scale projects are financially viable.	n/a
0.2	There is a tradeoff between producing biofuels and biochar... if a producer produces more biofuel than biochar does this impact the carbon value of the biochar produced?	Jeff Schahczenski	No. The tradeoff is factual. The result will be less biochar produced, and more biofuels, but assuming the biochar is of the same relative 'quality', the value of the biochar will remain the same.	n/a
0.3	Are we going to see this protocol submitted for inclusion into California cap-and-trade?	Steven Neoh	The protocol is currently being adapted for application with the Alberta (Canada) and the California Association of Air Pollution Control Officers Association offset systems. This work illustrates the opportunity for these methodologies being included in	n/a

	Comment	Commenter	Response	Changes to Methodology
			other offset system. Others are encouraged to work with the protocol development group to move this protocol into additional carbon market systems – including California's cap-and-trade market.	
0.4	The authors could consider splitting the protocol into multiple documents to address different project types (e.g. agricultural waste projects, forest waste projects, etc.). Doing so would facilitate the addition of more specific criteria for projects, if needed, while keeping the protocols concise. However, this reviewer understands the advantages of covering multiple project types under one protocol.	John Swanson	The methodology is designed to encompass multiple project types and where necessary defines criteria for different baseline scenarios (section 5) and sustainability criteria for different feedstocks (appendix 4). Additionally, mixed feedstocks may be utilized that include both agricultural and forest wastes.	n/a
0.5	A significant amount of work has been invested in the development of the "*Methodology for Biochar Projects*", prepared by The Climate Trust, The Prasino Group, The International Biochar Initiative and Carbon Consulting, and submitted to the American Carbon Registry. However, the proposed methodology is insufficient to reduce atmospheric CO2 concentration levels because offsetting on its own is not an	Ruy K. Anaya de la Rosa, Jim R. Jones	We recognize both of the mentioned short-term and long-term goals and that in order to eventually reach long term goals we must start somewhere. The carbon offset market has been set in motion and while it does not provide a full solution, it provides a platform to begin and it does allow methodologies for GHG emission reductions and GHG sequestration to be developed and improved. This	n/a

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	emission reduction strategy, but an allowance scheme to permit fossil fuel users to pay others to compensate for their actions. For global warming and soil function, net carbon sequestration is the ultimate goal and so, in order to achieve this, biochar projects must be developed with both short term and long term objectives. In the short term, it is important to promote the growth of sequestration technologies, such as biochar, where carbon-offsetting markets may be an important financial instrument to achieve this. In the long term, the sequestration benefits rather than offsetting need to be recognised to drive the world towards negative emissions. Here it is necessary to value sequestration in a new way. The document "*Methodology for Biochar Projects*" falls short on providing the mechanisms for these aspirations. The following commentary has been prepared, focusing on the technical aspects.		effort has been put forth with the understanding that document can and will be improved through modification. This is a first attempt and with it we hope the biochar industry can gain experience, learn and improve. This methodology provides one framework from which to begin and through the use of carbon credits provide support for more viable businesses to become established.	

1. Methodology Description

	Comment	Commenter	Response	Changes to Methodology

	Comment	Commenter	Response	Changes to Methodology
1.0	The Title seems understated. Couldn't this document be used as: "A Protocol for Verification or Certification of Carbon Offsets for Biochar Projects"?	Rob Lavoie	While the suggested title points out that this methodology is for verifying and certifying carbon credits, this methodology was submitted to American Carbon Registry, which is a standard for verifying and certifying carbon credits of all project types. By listing this methodology under this standard, we feel the intent of this methodology is self-evident.	n/a
1.1	Page 1: do not use term MSW. Use urban biomass or similar. MSW has focused definitions which are likely to bring lots of opposition.	Gregory Stangl	While we understand hesitations around using the term MSW, it is the universally accepted term for such materials. Further, the IBI Biochar Standards clearly indicate that only the biomass-fraction of MSW is permissible for use as a biochar feedstock, and that any MSWs containing hazardous materials are not permissible for use as biochar feedstocks.	n/a
1.2	In the first sentence, the *Biochar Methodology* states that "Biochar is produced through the Pyrolysis of biomass." Both pyrolysis and gasification involve oxygen-starved thermal combustion of biomass, but there is a very	Peter Thomas	See Comment/Response 1.4	See 1.4

	Comment	Commenter	Response	Changes to Methodology
	important difference between the two technologies. The draft *Biochar Methodology* includes extensive discussions of bio-oil, but gasification produces no bio-oil or other liquids. Our waste-heat dryer processes ~120 metric tons of raw manure or poultry litter per day or ~40,000 tons of raw manure or poultry litter per year per system. Each gasifier processes ~50 tons of dried manure or dried poultry litter per day, and it produces ~8.5 tons of granular, nutrient-rich biochar per day (i.e. 3,000 tons of biochar per year). The *Biochar Methodology* is not the first document that fails to distinguish between pyrolysis and gasification, and it certainly won't be the last. However, we would sincerely appreciate it if you would change the first sentence to read "Biochar is produced through the Pyrolysis or Gasification of biomass," and add the term "Gasification" after each time the term "Pyrolysis" is used. Making this change would provide continuity with USDA-NRCS *Conservation Practice Code 735*, and the USDA			

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	National Organic Program's *Materials Approved for Organic Crop Production*.			
1.3	Is there a real distinction between torrefication of feedstock vs. biochar production?	Vivienne Long-Speer	Torrefaction involves heating the feedstock to temperatures of 200 degrees C – 300C at slow heating rates (<50 degrees C/min) under an anoxic atmosphere at near ambient pressure (pg. 34 – Lehmann and Joseph 2009: Tito Ferro et al, 2004, Bergman and Kiel, 2005). Pyrolysis is the chemical decomposition of organic materials by heating in the absence of absence of oxygen. Fast Pyrolysis (on the order of 5 – 10 sec to 400-55 degrees C) and Slow Pyrolysis (up to 30 min to 400 degrees C). (pg. 342 Lehmann and Joseph 2009). Section 1.4 Definition of Pyrolysis: The thermochemical decomposition of a material or compound into a carbon rich residue, non-condensable combustible gases, and condensable vapors, by heating in the absence of oxygen, or low	n/a

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			oxygen environment, without any other reagents, except possibly steam (United Nations 2012c)	
1.4	Carbon Venture Partners applauds the progress that has been made in the biochar arena and appreciate that a methodology for the carbon benefits of biochar is put forth in this Draft Methodology. The Methodology is broad in scope and we have several comments and questions. This document notes pyrolysis in many places in the Methodology, implying it is the preferred thermochemical process for producing biochar. *Is biochar produced by pyrolysis meant to be the only acceptable thermochemical process for the biochar to be eligible?* For example, it is not clear whether high carbon wood ash (with biochar characteristics) produced in a traditional biomass power plant using wood for fuel would be eligible for consideration (if it could meet the required chemical and physical characteristics in the Methodology for biochar). High carbon wood ash from wood-fired biomass power plants has	Victoria Evans	This is a good point. The IBI Biochar Standards do not mention a specific thermochemical conversion process i.e. pyrolysis, because the Standards, as well as this Methodology, are meant to be technology neutral. There are other processes such as gasification that can produce biochar. For this reason,we agree to change the term "pyrolysis" in the methodology to "thermochemical conversion" process to indicate that there other different processes that can produce biochar. With respect to wood ash, as currently written the IBI Biochar Standards do not preclude this material as long as all conditions of the Standards are met including passing all required testing, but also meeting operational control requirements and being able to monitor "material changes". TK and PW -The product must meet the chemical standards of IBI	1.4 Definitions - "pyrolysis" and "gasification" were replaced with the term "thermochemical conversion" process, throughout the Methodology (Pyrolysis and Gasification are defined, as they do occur in specific instances in this Methodology)

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	been studied and found to have very similar characteristics as biochar (such as carbon content and surface area). As well, the benefits of this material has been evaluated on crops and found to be similar. *Is this high carbon wood ash material considered eligible for consideration as biochar, if it meets the required chemical and physical characteristics?* We recommend the biochar methodology be amended throughout to consistently and clearly state whether or not biomass power plants and other thermochemical processes are specifically included as eligible.		Biochar Standards. It is intended that as the technology and research understanding s progress, so will the standards and this methodology.	
1.5	Is biochar equally useful in aerobic and anaerobic conditions (e.g. rice)?	Fahd Rasul	We cannot make any comment on the utility of the biochar in any particular condition. The applicability criteria for the protocol provides boundaries for the areas where the protocol has sufficient certainty that the GHG calculations therein hold.	n/a
1.6	What happens to the allocation of CO2 credits if either feedstock or biochar crosses country boundaries?	Thomas Rippel	The protocol will be amended to reflect that where there are no air quality standards (Point 6 of Applicability Criteria), then the proponent should apply those	2 Applicability Conditions #6 - Geographical applicability was clarified.

	Comment	Commenter	Response	Changes to Methodology
			standards applicable to a developed nation. Protocol language to change to the following: For projects where the biochar is produced in a developed nation, the technology used for producing Biochar must meet all applicable local, regional, state, and national air quality Standards in the nation of Biochar production. For projects where the biochar is produced in a developing nation, the technology used for producing Biochar must meet all applicable local, regional, state, and national air quality Standards applicable in a jurisdiction from a developed nation of the proponents choosing. Project Proponents must present relevant documentation to indicate that regulatory expectations have been met. Discussions about the potential use of the methodology in developing countries (which is not prohibited, and is thus allowed), we agreed	

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			that the major limitation to allowing use in developed countries was lack of regulations, and so agreed that any developed country regulations could be used (e.g. air emissions, etc.) in projects located in developing countries.	
1.7	Why would the carbon offsets accrue to the producer rather than the farmer who actually buries the biochar? Is the decision to award the producer simply a matter of expediency because that is the point in the production-user chain where it is easiest to apply? Doesn't this invite scams in that the product might then just be burned as fuel? Isn't it important that the farmer, who has a hard enough time making a living anyway, be encouraged to use biochar by providing a 'use' incentive?	Michael Irwin	The carbon credits accrue to the Project Proponent which may be the biochar producer, farmer or any other entity that undertakes, develops and/or owns a project under the methodology. The Project Proponent must demonstrate uncontested and exclusive claim to ownership of the GHG benefits derived from project activities. It is entirely possible that a farmer who utilizes biochar can (a) be the project proponent (and thus own the credits, and/or (b) contract with the project proponent for a percentage of the credits. Section 6 details validation and annual monitoring requirements intended to avoid fraudulent activity. If a farmer where biochar is land applied as part of a project is not	

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			the Project Proponent, he/she will still benefit from the agronomic value of the biochar.	
1.8	Based upon a review of the document, it appears in some sections that the intended audience is small scale operations located outside of developed countries. In other sections, it seems the authors' intention is to cover both small and large scale operations, in all countries. Our confusion is further supported by the reliance on CDM related procedures/methods that are not commonly used for offset projects in North America. *Could the intended geographic scope of the methodology applicability as well as the intended project scale be clarified in the Final Methodology?* To address this issue, one option is to separate the Biochar Methodology into two sections or into two documents to address the geographic applicability of additionality requirements (CDM and non-CDM countries) and the analytical requirements that could vary by project scale (small versus large).	Victoria Evans	The Methodology is intended to use in projects in any country and at any scale. Guidance is provided in the Methodology l to assist with issues relevant at each scale and the level of development for the country. As such, the Methodology is applicable to all projects that can meet the requirements within the Methodology. However, there are some criteria and requirements within the Methodology that may limit the applicability in some geographies and at some scales. This is necessary, at this stage, to ensure the rigour of this document. Further iterations or adaptations of the Methodology to other project types may be appropriate in the future. The methodology can/will be updated as science and technology dictate updates and revisions.	In 1.4 Definitions – "pyrolysis" was changed to "thermochemical conversion" process In 2 Applicability Conditions #6 - Geographical applicability was clarified.

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	CVP also notes the Methodology focuses upon specifying the process producing the biochar, while we suggest the focus should be upon the quality of the biochar and compliance with the physical and chemical requirements needed to be eligible. The biochar production processes discussed in the Methodology reflect a viewpoint in time that may not include all of the advanced technology development/deployment that is currently underway and that is expected in the future. We recommend the Final Methodology allow the flexibility to include these rapidly improving and advanced biochar-producing technologies.			
1.9	We note that several terms are used throughout the Methodology and no definition is provided in the Definitions section. These undefined terms include 'Bioenergy', 'Biochar Reactor', 'Bio-Oil', 'Reactor', Non-biogenic fuel', 'Syngas' and 'Thermochemical'. CVP recommends that definitions be provided in the Final Methodology for each of these terms.	Victoria Evans	Agreed, that it can only be helpful to provide definitions for clarification.	In 1.4 Definitions - Added definitions for: Bioenergy Bio-oil Gasification Non-biogenic Syngas Thermochemical conversion

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1.10	The methodology should keep the condition that credit is given to producers upon production and attestation that biochar will not be combusted. Due to the economics of producing biochar, Interra agrees with the methodology awarding credit upon production of biochar and the attestation that the biochar will not be used for a fuel or combusted. However, as mentioned above, Interra would encourage the methodology to expand beyond an attestation of use in soil, to an attestation of any use that does not involve combustion or a release of the stable carbon component.	Interra Energy	Ownership is not defined in protocols as a matter of course as this is a legal matter. The protocol may, however, provide some guidance on who the parties are and where the emission reduction(s) occur. This helps define the parties that may have a claim on the offsets. Further, attestations have been shown to be insufficient in most cases. As such, more direct evidence of an activity is typically required.	n/a
1.11	The document should contain calculations on the magnitude of the amount of carbon sequestered. How much ag waste from a typical Midwest farm size would equal how many fractions of one coal burning utility? I note that the avg of the top 100 coal burning utilities in the USA = 12,000,000 metric tons CO2/ yr. we need some ref point to how much our	Bill Haaf	Good suggestion.	Provided an example under equation (39) in Appendix 2.8

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	BC is or can offset.			
1.12	On page 4, in the last sentence of the second paragraph, the authors could consider clarifying that the bio-oil and syngas, if used as renewable energy sources, would reduce anthropogenic emissions specifically by offsetting fossil fuel use.	John Swanson	Added this point for clarification	In section 1.1 end of second paragraph - Inserted new language as suggested
1.13	The goal of CDM AMS III.E mentioned in the document is not correct. The goal of CDM AMS III.E is to avoid the production of methane from decay of biomass and not to prevent pyrolysis as stated in Table 1.	Ruy K. Anaya de la Rosa, Jim R. Jones	Correction made.	Correction Table 1 pg. 5

2. Applicability Conditions (TK)

	Comment	Commenter	Response	Changes to Methodology
2.1	Sec 5c what about Biochar as filtration? Why just for soil? Biochar in landfill serves same carbon sequestration purpose. Sec5c be wary of term soil amendment. It's taxable. We have qualified Biochar as specialty ag mineral which is not.	Gregory Stangl	The methodology is restricted to use of biochar in soil since the embedded Standards (IBI Biochar Standards 2013) were developed for biochar used in soil. Biochar placed in soil for agricultural purposes provides ancillary benefits such as enhanced crop productivity and farmer income. Biochar used primarily for filtration is not excluded as long as it is placed in the	n/a

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			soil. The developers of this methodology are keen to promote its use in soil because of the multiple benefits that accrue, and to avoid negative optics of, for example, landfilling biochar. Soil amendment is a universally utilized term by regulatory agencies and other groups. While there may be tax implications, the intent of this methodology is to mainstream the use of biochar, not to marginalize it as a fringe material.	
2.2	The authors do not specify the geographic region where the methodology can be applied. It would be helpful to have specific language about where the methodology can be applied (globally, only in the United States, just the tropics, etc.). It would also be helpful if there was specific wording on the types of land where feedstocks can be obtained (private, public, all lands, etc.).	L&C Carbon	During Team discussions, there was an express desire from Prasino Group and Carbon Consulting that this be global and scope, though it was pointed out that the IBI Standards apply only to developing countries, due to need for regulatory limitations and oversight of potential environmental impacts. Regarding types of lands, in general, there are no restrictions on land ownership types for feedstock procurement as long as all requirements of the IBI Biochar Standards and Appendix 4 feedstock sustainability are met (e.g. sourcing feedstock be permitted	See 1.6

	Comment	Commenter	Response	Changes to Methodology
			from protected areas, because this is excluded in the standards and feedstock sustainability criteria).	
2.3	What restrictions (if any) if feedstock is used to make fuel (natural gas or electricity)? The residues would be composted.	Vivienne Long-Speer	Co-generation and biofuels are allowed. However, this methodology only credits biochar production and requires the production to optimize (meet IBI Biochar Standards 2013) for Biochar quality for soil amendment purposes.	n/a
2.4	In Québec, as in many boreal forest regions in Canada, forest fires occur on a regular basis. While climate change and other factors might increase their frequency, and their intensity, those are considered natural. Below the 50th parallel they are fought by provincial authorities (SOPFEU in Quebec) and above the 50th parallel, they are left to burn. Those fires can cover huge areas. Imbedded in logging rights agreements, authorities request forest companies to harvest the logs left standing after fires. This harvest can only be practiced for a limited time period: usually 12 to 24	Boris Voyer and Benoit Lambert, Biochar Generation	There are no restrictions or prohibitions from using non-combusted dead trees as feedstock. In this scenario, the harvesting of standing dead trees for biochar production post-forest fires represent could be considered "residues from forestry activity" since it is specifically endorsed by provincial authorities in Canada. As with all feedstocks in this methodology, the material would still have to meet all conditions in Appendix 4 Feedstock Sustainability. Also note that there is an important distinction between this scenario and from proposals that burned trees be utilized as biochar. In the	n/a

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	months, after which insects get into the wood that lose its value. Often 50 to 70% of the burned trees are left standing dead. When reforestation measures are taken, they sometimes represent a serious obstacle to terrain preparation, and event a hazard for tree planters. Our company is considering using that left behind biomass to produce biochar respecting “Appendix 4: Sustainable feedstock criteria”, in particular “to ensure that carbon stocks and other critical soil and ecosystem attributes are respected”. Yet, in our opinion, it should be made clear that residues from forest fires are included in the IBI Biochar Standards (2013). This biomass is not “residues from forestry activities”, but dead trees left after a forest fire. The definition of biological material and biomass in Appendix Glossary - Definition of Terms (p. 38), does not mention biomass left after forest fires. We believe a clarification might be needed. Hoping this is useful, we want to		latter instance, the material would not meet the requirements of the IBI Biochar Standards.	

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	congratulate The Climate Trust, The Prasino Group, the International Biochar Initiative and Carbon Consulting for this remarkable piece of work.			
2.5	Can a project have more than 1 potential feedstock certified for an individual project?	Erin Rasmussen	Yes. Biochar can be made from a single or multiple feedstocks, as long as all feedstocks used meet requirements of the IBI Biochar Standards and Appendix 4 sustainable feedstock criteria.	n/a
2.6	The wording of this paragraph is unclear (original in italics): *Biochar that is specifically designed and intended as a Soil Amendment presents a disincentive to combustion due to changes in its physical and chemical characteristics, or poor return on investment as a fuel source.* What changes, and from what starting point? Poor return on investment as a fuel source is not explained, but presumably refers to the heating value of the biochar compared to that of a charcoal. However, the production processes and conditions overlap, and some of	David Wayne	The commenter makes good points here. The criteria are options for providing tangible evidence that the biochar is soil applied. However, tracking the biochar to the point of soil application will not be logistically or economically feasible. In Section 2.5 of the Methodology, demonstrating that the Biochar has been mixed or blended with other Soil Amendments/Materials is one of the options for providing substantive proof. The references in this comment are important to the justification of how biochar applied to soil is not going to be used for combustion (either as	Section 2.5: Inserted text for clarification: "When the biochar is mixed with soil, the energy content of the combined material is significantly lower than as biochar alone."

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	the char currently sold as 'biochar' has been made by charcoal producers using their established techniques; the charcoal-process fines must be assumed to have the same calorific value as the larger pieces. Lower H/C ratios in biochar will result from pyrolysis at higher temperatures and/or for longer times, taking the (bio)char into compositions typical of char sold as charcoal. *Assurance of the stable sequestration value of Biochar is therefore provided through attestations related to the material's end use. Such end use attestations must be guaranteed by the presentation of substantive proof, through the application of Biochar to soil, the type of product sold, the blending of Biochar with other amendment materials, and additional features described below.* Demonstration of application to soil or admixture with other amendment materials is a much more secure guard against deflection to fuel use, but see below.		part of the soil matrix or upon some separation). The changes in the biochar discussed relate to any inoculation or hydration that may occur in order to maximize the benefits from biochar application to the soil.	

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2.7	'Price' is not defined anywhere in section 2. It is not made clear whether the price referred to is the price the producer might receive, or the wholesale price, or the retail price. The retail price will generally differ greatly from the producer's price. At present a proportion, probably a high fraction, of the biochar sold is offered in small packs at outlets such as garden centres where most of the price reflects retailing costs and profit. Consider as an example price relationships in another long-established soil amendment, lime. In UK garden centres small packs of 'horticultural lime' are sold at high prices (eg 2.5 kg for £6) reflecting a cost to the purchaser of £2400 per tonne of lime. However bulk suppliers charge between £5 and £26 per tonne for lime, depending largely on the magnesium content. The producer's price for the content of the small pack is therefore only 1 or 2p. The retail prices of small packs of products containing biochar are a very poor indication of the prices biochar producers can get	David Wayne	(Section 2.5b) Production price is what was intended here.	In Section 2.5b, "price" was clarified as "production price" in the section title.

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	when they sell the contents for the small packs to the retail business. These considerations will apply yet more strongly in the bulk markets that biochar will have to enter if it is to become anything more than a fashionable niche product, sold (like cosmetics) more on hype and hope than on demonstrated quantified benefit.			
2.8	The paragraphs under the 'end use' heading. 'Substantive proof' can be offered through several methods, one of which is by presenting information in two categories of three: the size of particles, the comparison of heating values, and marketing. None of these are sufficient guarantees of the end use, or provide a robust barrier to deflection of biochar into charcoal markets. Taking them in turn: 1. **Size of the particles**: there is a large trade in 'machined' charcoal or charcoal briquettes. These products are made by compressing small particles into	David Wayne	(Section 2.5) Yes, end use is difficult to prove. This methodology offers tangible and substantive evidence. See response to 2.6	See 2.6

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	shapes, with or without a binder. It appears that the small pieces may be pyrolysed before or after compression into convenient shapes. Pyrolysed sawdust is a common precursor. Consequently a producer who demonstrates that his product passes through a 5cm sieve, as the draft stipulates, could easily sell his material as a feedstock for machined or briquetted charcoal. 2. **Comparison of heating values**. I have argued above that the heating values of chars intended as charcoal or as biochar, overlap. The lower the H/C ratio, the lower the O/C ratio is likely to be and the more stable the char will be judged as biochar; but it will also have a higher heating value when judged as charcoal. The Protocol would need to set out a much better case to sustain the argument behind this test. 3. **Marketing**. An unscrupulous producer could promote a			

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	biochar product, and sell part of his production as biochar, while deflecting the remainder of his production into the charcoal market – but claiming carbon credits for the whole production. These fraudulent practices should be detected on audit, but demonstrating compliance with two of the three tests as the draft proposes adds little or nothing to assurance that the product is destined for biochar uses.			
2.9	**Relative values of biochar and charcoal**. There is a and well-established charcoal market offering wholesale products in the price range $250 to $1100 per tonne (on a quick look!). A presentation at the USBI conference in 2012 estimated total sales of biochar products in recent years as 430 tonnes. Even if we suppose the estimate is too low by a factor of 4, the scale of activity so far is minute. An annual production and sale of 1000 tonnes of biochar might support a claim for 400 tonnes of stable C stored in soil. If we estimate	David Wayne	The authors agree that large-scale projects will be needed in order to justify the transaction costs associated with monitoring and verifying according to the methodology. This was not the intent of the authors, simply the result of the requirements needed to ensure the environmental integrity of the Methodology. The authors believe that sufficient criteria are in place to ensure that biochar is soil-applied, even if biochar did not command a price premium over fuel charcoal in the	n/a

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	the price of a biochar sequestration carbon credit as 3.67 times the CO_2 price, and take the CO_2 price as $20, then the carbon credits might be worth 400x3.67x$20 = $29360. Operation at that sort of scale would be necessary to make worthwhile the effort of certification and registration under the protocol, and selling the credits, even with assumptions that are optimistic at present. That implies however that a single manufacturer would need to sell more each year than the combined efforts have achieved to date. The protocol needs therefore to look forward in anticipation of a much larger production of biochar and its sale into markets that are broad and deep. It is not clear that biochar will command a price premium over fuel charcoal then. Framers who may consider buying biochar are unlikely to be willing to pay more that some fraction – probably less than one-half – of the value they expect for the extra production, and they may be willing only to consider the extra		distant future.	

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	production of the first year or two. The total value of a tonne of biochar will be the sum of the carbon credit and the amount a user is prepared to pay, recalling again that we must think in terms of the price the producer would get, not retail prices. It would be convenient if the agronomic value were a little less than that of charcoal, but the combined price were greater. Then there would be less incentive to deflect biochar into the fuel market, and schemes that had to pass high sustainability standards to be approved for carbon credits would provide a mechanism to control indiscriminate or illegal exploitation of native forests for biochar feedstock. Clearly we cannot determine the price by what is convenient.			
2.10	Sorry not have time to do a deep analysis of this methodology. Although I do not know all technical details of biochar, the product calls me my attention as key product to combat climate change and desertification. I think that product	Miguel Cortes	Recognition of the co-benefits of Biochar is appreciated. 1. The definition of Feedstock does not include non-biogenic materials, such as textiles, glass, plastics, and metals. Note, that the IBI Biochar Standards do, however, permit a no	See changes in A4.6

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	could help significantly to agriculture in reduce fertilizers, fuel consumption and avoid water eutrophication. In general context, the application and development of biochar as soil amendment contribute to reduce not CO2 equivalent emission and could help to communities for promote responsible agriculture. In terms of methodological procedure to account the emission reduction associate I have followings: 1. I think that the use of terms feedstock term and type of feedstock materials allowable are not convenient. As I could see in applicability condition the methodology has been limited to "biomass residues", therefore feedstock definition seems not compatible. Furthermore materials such as textiles, Glass, plastic, metal, other inert waste (non-biogenic) in my opinion are not compatible. 2. Agree that the methodology should be limited to biomass by-		more than 2% by dry weight of Contaminants which include "fossil fuels and fossil-fuel-derived chemical compounds, glass, and metal objects." 2. The previous application of the biomass feedstock is intended for producers of biochar to take into account the economics of the local community. The intention of accounting for "previous application" is that we are working under the guidelines of causing "no net harm". If significant fossil fuels were being used in the previous application that would be taken into account and weighted against the climate benefits of Biochar. 3. Dedicated forestry plantations have not been included as an approved feedstock because there are many factors to take into account with regards to GHG accounting, such as the disturbance of sequestered carbon in the soil, additions of fertilizer and water, qualifying degraded land. At this point the GHG accounting for such practices is more complex than was	

	Comment	Commenter	Response	Changes to Methodology
	products but this limitation shall be focused on the criterion of renewable biomass as CDM applied and apply criteria to avoid the competition between biomass residue products. I means that if the biomass residues use on biochar production have other previous application, finally the economic criteria could promote or there is a high risk that project activity promote other fossil fuel. I cannot see clearly how the methodology could prevent or account this issue. 3. On this way, it think that it is a mistake not to consider the possibility to use dedicated forestry plantation for biochar production; mainly in case that there is a high chance to use severely degraded land that could convert on biochar biomass. As my point of view biochar does not need strictly standard on biomass, therefore it could promote some type of harvest for biochar. CDM has been developed guidelines and tools to account this type of possibilities. 4. I think that some description		acceptable for a first of its kind methodology. This Methodology is limited to biomass residues. 4. The commenters raise important points that merit clarification in the appendix. We have significantly expanded the appendix to clarify the process for demonstrating that feedstock procurement does not incur net negative impacts. Material changes > 10% are required to be retested. Categories are broad in an effort to streamline this approach.	

	Comment	Commenter	Response	Changes to Methodology
	seems contradictory or make confusion with the term biomass residues such as "*If Biochar has been produced from Feedstocks of mixed origin"*. The methodology should avoid any type of reference of product combination and probably to be more explicit on Appendix 4.			
2.11	The available end use of biochar needs to be expanded to include other non-combustion uses. As it is currently written, the biochar methodology limits the end use of biochar to agricultural uses where biochar is applied to soil. By limiting to such uses, the methodology deprives producers from selling biochar into other markets where the carbon stability would not be compromised. For example, there is the potential to process non-hazardous Municipal Solid Waste and convert it to biochar. However, the biochar would not be ideal for agricultural uses and would be better served being stored in the landfill (but not necessarily in soil). Such a use is not explicitly allowed by the	Interra Energy	Non-Combustion Uses: See 2.1 response Activated Carbon/Filtration: See 2.1 response Producers can still produce and benefit economically from making Biochar for filtration purposes. However, if the ultimate end use is not as a soil amendment, than it will not be eligible for Carbon Credits under this Methodology. (If the filtered material is no fit for agricultural use (i.e. it is toxic, then it will not be eligible for credits)	n/a

	Comment	Commenter	Response	Changes to Methodology
	methodology, but would provide a similar carbon benefit. Further, there is a large market for biochar in the activated carbon market. In this market the price per ton is often far greater than that in the agricultural market. In the activated carbon market biochar is used as a filtration device, mostly for water purification projects. After used for filtration the biochar is often discarded in a local waste facility. Under these circumstances, the stable carbon component remains the same as in the agricultural use. Further, the same rationale of high costs would deter any buyer from using the biochar as a fuel source. Interra would strongly encourage the methodology be adapted to allow for alternative end uses of biochar. Of course, if the activated carbon were used such that the stable carbon content was compromised it would not be credited. If these uses are not allowed, Interra would like to ensure that project developers would be able to			

	Comment	Commenter	Response	Changes to Methodology
	produce both biochar for soil uses as well as biochar for use as activated carbon or other non-combustion uses. Even if the activated carbon portion is not credited, it can help the project economics and ensure the stability of the project.			
2.12	If we really believe that the impacts from a hotter planet will be severe with loss of life and loss of biodiversity - then why limit the final end use of Biochar to mix with soil or other materials to avoid burning? Why not allow other techniques? Eg: water disposal? in lakes or oceans or pits then covered with soil or water or somehow not able to be burned? Please look ahead and be flexible. Or - in Coal mines covered with water? it may come to the point that we need to produce copious amounts of BC - more than local soils can handle. Same comment on restricting those materials "purposefully grown".- again we may need to strive to decrease the CO2 in the atms quickly and growing say bamboo or whatever on marginal land and	Bill Haaf	See above 2.14 comment rationale for restrictions Regarding exclusion of feedstocks from purpose grown crops, while we understand that functionally such feedstocks could serve to draw down atmospheric CO2 concentrations, the concern about land use change resulting from purpose grown feedstocks is significant enough to merit prohibition of this practice. Experiences in the related biofuels industry document the widespread replacement of native and high value ecosystems for purpose grown biofuel crops—this is indirect land use change. Further, the replacement of food crops for biochar feedstock crops, i.e., direct land use change, poses concerns around food security. Using marginal	n/a

	Comment	Commenter	Response	Changes to Methodology
	converting that to BC may be urgently needed. Add marginal land as an option for purposefully grown. Or case by case exemptions.		lands that are not being cultivated may be an option to circumvent land use change concerns; however, there are no widely accepted means to determine marginal lands. For these reasons, at this stage in methodology development, we propose prohibiting purpose grown biochar feedstocks.	
2.13	Although the protocol is written with a scope that is broad enough to incorporate several different types of biochar projects (e.g. municipal solid waste, agricultural waste, forest waste, etc.), the criteria for documenting and verifying various aspects of projects are somewhat vague and subjective, in some cases. To establish robust documentation that supports the integrity and verifiability of biochar offsets, some criteria may need to be more specific. For example, the requirements for "agricultural records" or attestations establishing the application of biochar to soil may need more specific detail, or	John Swanson	The commenters raise important points that merit clarification in the appendix. We have significantly expanded the appendix to clarify the process for demonstrating that feedstock procurement does not incur net negative impacts.	See changes in A4.6

	Comment	Commenter	Response	Changes to Methodology
	quantitative criteria to support traceability and verifiability.			
2.14	Under the applicability conditions, Number 1, on page 11, the protocol states that only waste residues are eligible for feedstocks, and that crops purposefully grown with a primary function of biochar feedstock production are not eligible. While this limits the scope of possible projects, this element is important and probably essential to prevent leakage from the conversion of land used to grow food crops (at least at this stage in the development of biochar projects). The restriction also addresses additionality and sustainability concerns by limiting feedstocks to residues that would otherwise be combusted or left to decompose.	John Swanson	Agreed	n/a
2.15	In the interest of supporting and encouraging further commercial biochar production, it is probable that limiting sources of feedstock to waste stream residues would unduly limit sustainable practices and innovations. I gather that a working assumption is that utilizing purpose-	Jonathan Scherch	Good points. This will be taken into consideration potentially for a later version of this Methodology.	n/a

	Comment	Commenter	Response	Changes to Methodology
	grown crops for biochar could occur at odds with what might otherwise be crops allocated for meeting consumers' needs and demands (i.e. food vs. energy products). Consider domestic bamboo crops which could be harvested without depleting soils or use of petro-chemical fertilizers, in harmony rather than competition with food crops, adding additional economic resilience for farmers going to market, and utilizing an excellent biomass source at once. Done well, bamboo can be cultivated amid a synergistic agroforestry program which can create and sustain multiple site-specific benefits (including reduced energy-input methods) which could differ significantly from the energy inputs required to tap and use residue biomass sources. We could be adding value and advantage to our emerging biochar industries by thoughtfully utilizing purpose-grown bamboo resources in addition to residual materials. Visit www.resource-fiber.com for more information on the establishment of the U.S. bamboo			

	Comment	Commenter	Response	Changes to Methodology
	industry.			

3. Project Boundaries (DR)

	Comment	Commenter	Response	Changes to Methodology
3.1	Why is the crediting period 7 years? Why not longer?	Jeff Schahczenski	This is a requirement of ACR (The American Carbon Registry Standard v3.0) - "The Crediting Period for non-AFOLU projects shall be (7) years." As this is a new methodology and in order to incorporate additional field research findings, we agree with ACR's requirements, "Crediting Periods are limited in order to require Project Proponents to reconfirm, at intervals appropriate to the project type, that the baseline scenario remains realistic and credible, the Project Activity remains additional, and GHG accounting best practice is being used." ACR does not limit the number of times a project	In section 3.2, clarified that there is no limit to Crediting Period renewal.

	Comment	Commenter	Response	Changes to Methodology
			crediting period can be renew (so long as validation/verification and other requirements in the ACR standard are met) and nor does this methodology. See comment/response 3.5	
3.2	I have seen forest biomass include green leaves and needles chipped along with wood in preparing feedstock for pyrolysis. What happens to the phosphorus, potassium, magnesium, and trace elements when this is done? Shouldn't production of feedstock avoid including leaves, needles, and growth tips in order to avoid depleting the soil of such nutrients?	Charles Ashley	The commenter raises important points that merit clarification in the appendix. We have significantly expanded the appendix to clarify the process for demonstrating that feedstock procurement does not incur net negative impacts.	See changes in A4.6
3.3	Page 19 excludes emission reductions from electricity production where projects are located in Developed Nations. Does this mean there would be no claim of the carbon benefit from U.S. electric generators fueled by syngas from biochar pyrolysis?	Brian KillKelley	There are other methods for crediting biofuels. This methodology is for Biochar production with the end use as a soil amendment only. This methodology does not exclude creating biofuels along with biochar production (it is required to optimize for Biochar), but it	n/a

	Comment	Commenter	Response	Changes to Methodology
			does not credit the biofuel production either.	
3.4	Why is biochar transport excluded from the boundary? p. 22 mentions "emissions are minimal given the economic limitations of transporting" - however i know of large amounts of biochar being transported 1000s of kilometers.	Thomas Rippel	Agreed. There are two reasons for excluding emissions from biochar transportation. First, because the baseline scenario excludes soil amendment transportation emissions, then biochar transportation emissions in the project scenario should also be excluded, assuming biochar replaces the baseline soil amendment. Second, while there may be instances of biochar being transported long distances, experiences in the contemporary biochar industry indicate that hauling large amounts (i.e., sufficient quantities to participate as a project under this methodology) of biochar is not currently economically feasible.	See 3.8 below
3.5	The seven-year crediting period is	Interra Energy	Note, as stated in ACR	n/a

	Comment	Commenter	Response	Changes to Methodology
	ideal for biochar projects. Interra agrees with the methodologies use of a seven-year crediting period. As there remains a lot of field research on biochar, it makes sense to limit the crediting period. As more studies are conducted, the ACR and developers will have a better idea of the stability of biochar under different circumstance and feedstock types. A seven-year period allows developers to get enough financial incentive to go forward with the project, but does not lock them in too long if the characteristics of their biochar change.		Standard v3.0: "Upon acceptance by ACR of the validation and verification documents, ACR will issue new ERTs each year (or more or less frequently, at Proponent's request) for the duration of the Crediting Period (7 years) provided the Proponent submits its Annual Attestation periodic desk-based verifications, and full verifications at least every five years). This Methodology requires feedstock testing whenever there is a material change in feedstock or production parameters.	
3.6	The project boundaries laid out in the methodology should remain unchanged. The project boundary correctly focuses on the production of biochar and leaves the application of biochar to other methodologies. The more focused this methodology can be the easier it will be for all	Interra Energy	Yes agreed, Biochar Application can and should be addressed in a separate Methodology.	n/a

	Comment	Commenter	Response	Changes to Methodology
	associated parties. If developers choose to use their own baseline scenario, with the associated calculations, then the burden will be on them to show why the boundaries should change for their unique situation.			
3.7	It's not clear to this reviewer why methane and nitrous oxide emissions from aerobic decomposition of feedstock are included as GHG emissions in the baseline scenario. They could probably be excluded, or additional explanation could be provided as to why they should be included.	John Swanson	It is well established that there are methane and nitrous oxide emissions associated with aerobic decomposition – including under the IPCC. Although very small, these emissions fall in the baseline and thus their inclusion provides a more complete assessment of the GHG benefits.	n/a
3.8	Under the project scenario, excluding the emissions from biochar transportation due to equivalency with the transportation of soil amendments would only apply if biochar is mixed with soil amendments. For biochar that is not blended with other soil amendments, the assumption that this source will be minimal due to the economic constraint on biochar	John Swanson	See response to 3.4	n/a

	Comment	Commenter	Response	Changes to Methodology
	transportation costs may not be realistically conservative. The authors could consider including these emissions if they are deemed significant for specific project scenarios, if biochar produced at a centralized location is transported to application sites before blending with other soil amendments.			
3.9	If the default baseline is converting biomass that would have been burnt for heat or electricity production to biochar, then it would make sense to include the energy source that replaces the bioenergy into the baseline, no?	Thomas Rippel	The most conservative approach for handling the baseline emissions associated with the biomass is its use in energy production. The energy source that replaces the biomass used for bioenergy is indirect and represents leakage. In this case, any higher GHG feedstock (i.e. fossil instead of biomass) would provide a higher baseline – thus it is conservative to not reach towards these indirect GHG emissions.	n/a
3.10	The methodology should account for losses of the biochar material that may occur during handling (e.g. pelleting, inoculation), transport	Ruy K. Anaya de la Rosa, Jim R. Jones	As documented in the methodology, losses such as translocation do not lead to lost biochar – it is just	n/a

	Comment	Commenter	Response	Changes to Methodology
	and application (Hammond *et al*., 2011). Furthermore, biochar material applied/incorporated can migrate out of the project boundaries (Major *et al*., 2010; Jaffé *et al*., 2013). Therefore, it seems unsatisfactory to neglect the migration of the biochar material out of the project boundaries and to assume that the fate of biochar over the 100-years time horizon does not affect the level of carbon sequestration that allows polluters to 'offset' GHG emissions.		misplaced, or placed elsewhere, and it is highly unlikely that losses during handling, transport, and appropriate application will be of any significance. (merge with your second point below…..) Regarding the second point, we acknowledge that biochar migration outside of project boundaries may occur. However, Appendix 2 page 121 provides justification for assuming that biochar translocation does not affect the long-term carbon sequestration potential: "Some studies indicate that a significant fraction of land-applied Biochar can be exported within the first few years following amendment, even when Biochar is incorporated into soil (Rumpel et al., 2009; Major et al., 2010b). However, physical transport of Biochar offsite does not necessarily result in	

	Comment	Commenter	Response	Changes to Methodology
			a CO_2 flux to the atmosphere, as the final fate of charcoal erosion from the land surface may be deposition in marine sediments. The intrinsic refractivity of charcoal in marine environments may lead to its long-term storage in sediments (Masiello, 2004). It is reasonable to assume that mobilized Biochar does not decompose, and remains a long-term carbon sink as it transits to the sea floor."	
3.11	The word '*albedo'* is not mentioned in the document. Yet, the application/incorporation of biochar can reduce soil albedo (Genesio *et al*., 2012; Meyer *et al*., 2012) and therefore aggravate climate change.	Ruy K. Anaya de la Rosa, Jim R. Jones	ANY enhancements to soil organic matter content will reduce soil albedo. We will thus disallow any soil improvements.	n/a
3.12	Figure 2 is confusing since the processes related to soil amendment are excluded later in Table 2.	Ruy K. Anaya de la Rosa, Jim R. Jones	The protocol is built using the ISO 14064 pt II standard. As such, the process of identifying (and illustrating in figures for the purposes of communication) of all potentially relevant sources, sinks and reservoirs	n/a

	Comment	Commenter	Response	Changes to Methodology
			(SSRs) of carbon is a requirement. The SSRs are then evaluated for relevance and inclusion in the protocol. In short, it is important to know what is outside the limits of the protocol to understand where the limits of the protocol are located.	
3.13	Methane (CH4) and nitrous oxide (N2O) emissions due to the implementation of alternative pathways (e.g. combustion of feedstock) may not be the "*primary source of emissions in the baseline scenario*" as stated in Table 2. GHG emissions from the fossil fuels used along the supply chain may be the primary source. Again, life cycle assessments (LCAs) will quantify the contributing emissions.	Ruy K. Anaya de la Rosa, Jim R. Jones	The term "primary" may be misleading. I do not believe this choice of language adds anything to the protocol and (as the reviewer point out) may not hold in all project configurations.	In Table 2 GHG Sources, removed the word "primary"
3.14	The word „*conservative*" is not used correctly. There are a number of instances as follows. (a) While it is practical it is not conservative (as stated in table 2) to exclude impacts arising from	Ruy K. Anaya de la Rosa, Jim R. Jones	The objective was not to quantify lifecycle GHGs, but to clarify if discrete sources are to be included in this Methodology. a) The conservative	n/a

	Comment	Commenter	Response	Changes to Methodology
	feedstock production. Since biomass residues have a value, the activities associated with the production of biomass should be allocated proportionally in mass or economic terms to the main crop as well as to the residues. However, one may exclude these upstream processes because the impacts will be the same for any of the alternative uses of the biomass. This is convenient for carbon accounting purposes but it is not conservative. (b) Excluding the above ground biomass pool is not a matter of following a conservative approach as stated in Table 3. If the application of biochar into soils increased the above ground biomass (as assumed in the methodology), this would become a larger carbon-neutral pool and could only result in long-term carbon sequestration if the biomass in the following rotation was converted into biochar and applied into soils. Therefore, the additional sequestration of carbon in the biomass would affect the amount of		assumption is simply stating that while there are emissions associated with feedstock production, they are excluded from the baseline which reduces the offsetting potential in the project scenario. b) Increases in AGB from biochar application may result in short-term (not long-term) carbon sinks—the sequestered carbon may be released upon harvest of the crop depending on its end use. We agree this may be the case for annual crops. However, woody/perennial crops in a biochar system may experience enhanced carbon sequestration on a multi-year basis. Excluding this scenario is conservative. c) The inclusion of the 0.95 correction factor in equation 33 is conservative. Published data demonstrate short-term positive priming effects in some but not all cases. Over	

	Comment	Commenter	Response	Changes to Methodology
	biochar produced in the following rotation and therefore would be included. If the above ground biomass was a cash crop (e.g. apples), then GHG ERs could be claimed if global crop (e.g. apple) production was displaced as a result of project implementation. However, this is highly unlikely. (c) The methodology also neglects the possible indirect stabilisation of soil carbon once biochar is applied and claims that this assumption is conservative (See page 108, which states "*The decision not to include these also reflects the conservative approach of this effort*") but it is not because negative effects are also possible. In fact, a 0.95 correction factor was included in equation 33 to account for positive priming. (d) Furthermore, on page 113, the document says that "*Beta methods provide an absolute measure for the carbon that will remain in Biochar for at least 100 years (at minimum, a conservative estimate of stability)*." While it might sound semantic here, the use of the word		the long-term (e.g., 100 years), however, small losses due to positive priming are more than offset by enhanced soil C storage via organic matter sorption to biochar and physical protection (Zimmerman et al 2011). d) For carbon markets, 100 years is the accepted timeframe considered to be "permanent". This methodology is developed within the framework of existing protocols and criteria for carbon markets. Because beta methods would likely indicate biochar C stability over timeframes much greater than 100 years, this is a conservative assumption.	

	Comment	Commenter	Response	Changes to Methodology
	„*conservative*" is confusing since carbon sequestration needs to be *permanent* to „offset" fossil fuel-derived GHG emissions and biochar will eventually decompose.			
3.15	The methodology excludes the impacts arising from the transport and the application of biochar, which are highly contextual and so it seems incorrect to exclude these processes based on the assumption that these will replace other soil amendments. This assumption begs the question: how much biochar would be needed to displace a given quantity of soil amendment for any given situation? Furthermore, biochar contains a range of nutrients which may need to be mixed with fertilisers to achieve the right elemental ratios required by the soil. Other reasons for biochar incorporation may be to avoid erosion of the soil or losses of the biochar itself, or to place it closer to the rhizosphere for soil improvement. For example, using a seed drill is more energy intensive than using a compost spreader.	Ruy K. Anaya de la Rosa, Jim R. Jones	The application of soil amendments to the land would not be materially different due to the inclusion of biochar. As such, the emissions from biochar application to soil are excluded.	n/a

	Comment	Commenter	Response	Changes to Methodology
3.16	The methodology states that "*The Crediting Period for this project type is seven years*" and data keeping shall include the "*Storage of all documents and records in a secure and retrievable manner for at least two years after the end of the project Crediting Period*". The monitoring, reporting, verification and crediting of the permanence of the sequestration of carbon over 100 years should not be acceptable for such a short period of time, i.e. 9 years. Because of the difficulty in measuring acceptable levels of minimum change in soil organic carbon (SOC) stocks on a yearly basis, a period interval of 10 years has been proposed for monitoring SOC (Saby *et al*., 2008). As a comparison, project developers claiming *temporary* carbon sequestration under the afforestation/reforestation category of the clean development mechanism (CDM), may select either 1) a 20-year crediting period, renewable twice (provided that the baseline is still valid or has been updated), or 2) a single 30-year	Ruy K. Anaya de la Rosa, Jim R. Jones	See 3.1 This is an ACR requirement (7 years is the maximum Crediting Period for non-AFOLU projects).	See 3.1

	Comment	Commenter	Response	Changes to Methodology
	crediting period. Since the life time of pyrolysis facilities is typically 20 years (Roberts *et al*., 2010; Woolf *et al*., 2010; Hammond *et al*. 2011; Ibarrola *et al*., 2012), it seems that the crediting period should be at least 20 years but this needs consensus.			
3.17	***The biochar methodology seems not to fully address the issue of the allocation of project emissions across different project stages.*** Assuming that the average biochar project will produce both biochar and energy as an output, a relevant question is if and to what extent the project-related emissions should either: a) be allocated fully to the char admission to soils, b) be fully allocated to the energy production component, or c) be allocated to both type of outputs (according to some robust allocation rule). The methodology only seems to allocate the auxiliary project-related emissions for further energy processing to the energy output while the 'upstream' project	The consortium partners of the project: INTERREG IVb North Sea Region, "Biochar: climate saving soils", led by the lead partner the Province of Groningen, the Netherlands, represented by the project manager F. Debets (fransdebets@debetsbv.nl)	This is already accounted for in exclusion of indirect emissions. Regardless of what baseline is used, the Project Proponent must account for all project emissions. See 3.9	n/a

	Comment	Commenter	Response	Changes to Methodology
	emissions (e.g. feedstock processing and transport) seem to be fully allocated to the biochar output. One could question if such a default allocation method[1] will also be considered justified and sufficiently conservative given the notion that some (future) biochar projects might technically be capable to optimize their output ratio's according to market conditions (e.g. feedstock prices and relative output prices).			
3.18	***The biochar methodology does not seem to take 'avoidance of fossil fertilizer use' into account, while CDM methodologies for this exist.*** In order to also provide project proponents with an opportunity to generate carbon credits based on this biochar project impact, there are two approved CDM methodologies that provide relevant guidance[2]. These two	The consortium partners of the project: INTERREG IVb North Sea Region, "Biochar: climate saving soils", led by the lead partner the Province of Groningen, the Netherlands, represented by the project manager F. Debets	There is not enough data to warrant accounting for 'avoidance of fossil fertilizer use.' In practice avoidance of fossil fertilizer use may or may not occur. This Methodology does not follow the Application of the biochar to the soil. Once the Biochar is no longer in the control of the Biochar producer, it	n/a

[1] See CDM approved methodological tool: "Guidelines on Apportioning Emissions from Production Processes between Main Product and Co- and By-Products" http://cdm.unfccc.int/Reference/Guidclarif/meth/meth_guid37.pdf

[2] AMS-III.A.: Offsetting of synthetic nitrogen fertilizers by inoculant application in legumes-grass rotations on acidic soils on existing cropland --- Version 2.0

AMS-III.BF.: Reduction of N_2O emissions from use of Nitrogen Use Efficient (NUE) seeds that require less fertilizer application --- Version 1.0

	Comment	Commenter	Response	Changes to Methodology
	methodologies would especially be useful for calculating the baseline emissions related to the avoided production and use of fossil fuel based fertilizers.	(fransdebets@debetsbv.nl)	would be nearly impossible to quantify fertilizer applications. Other Methodologies, such as MSU-EPRI address this topic.	

4. Procedure for Determining the Baseline Scenario and Additionality (KD)

	Comment	Commenter	Response	Changes to Methodology
4.1	[During the webinar] Keith said that the baseline is a biomass combustion system for energy production, but then talked about several other baselines including anaerobic digestion. Please go over how you would select the proper baseline for a project.	Kelpie Wilson	The procedure for selecting the baseline is outlined in the protocol as starting with a default approach and then providing additional options, where applicable. The default approach is provided where a project does not meet the requirements for any other baseline, does not have the required data, etc.	n/a
4.2	Carbon Venture Partners notes that the Methodology relies upon CDM-related additionality procedures and requirements as stated on page 30: "Additionality will be assessed and demonstrated using the most recent	Victoria Evans	The requirements for additionality used in the protocol can be applied in both developed and developing nations. The requirement to illustrate additionality in this way should not be a barrier to biochar	n/a

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Although this concerns two approved CDM baseline and monitoring methodologies, there currently (September 2013) is not one project in the CDM pipeline at any given development stage, which uses this methodology.

	Comment	Commenter	Response	Changes to Methodology
	version of the methodological tool "Combined tool to identify the Baseline Scenario and determine Additionality" as published on the UNFCCC website (United Nations 2012e)." As mentioned above in Section 1, CVP submits that these CDM-based procedures may be appropriate in some locations, just as the CDM project eligibility is restricted to certain countries. Application of conditions for CDM project additionality for voluntary offset projects in North America does not seem appropriate or even perhaps relevant. CVP is concerned that the reliance upon CDM-based additionality procedures will discourage biochar project development in North America and other areas that are not CDM eligible areas. Thus, the Methodology should be clarified to include additionality conditions that are appropriate for developed and undeveloped country locations.		projects. Instead, they provide best practice guidance for developers seeking to ensure that the offsets are real.	
4.3	Another potentially subjective	John	Assessment of additionality can be	n/a

	Comment	Commenter	Response	Changes to Methodology
	analysis is in Section 4.1, in Step 4 of the additionality analysis. This step analyzes the extent to which the proposed project type (i.e. technology or practice) has already diffused in the relevant sector and geographical area. Without quantitative constraints, it would be difficult to formulate any basis for rejecting the assertions associated with this criterion. Other subjective areas that could benefit from some additional criteria might include the substantive appropriate evidence for establishing alternative baseline scenarios (other than the biomass combustion scenario). A description of the types of documentation that would support legitimate projects could be included.	Swanson	viewed as inherently subjective. However, over time there has been established best practice. The framework provided in this protocol, when coupled with that with the ACR guidance and otherwise within broader GHG literature, represents best practice.	
4.4	The document suggests that in the absence of pyrolysis, the feedstocks would otherwise be used for bioenergy generation in the baseline scenario. This assumption is appropriate and conservative, but should also be compared to the status quo where the biomass is generally left 'in-field'.	Ruy K. Anaya de la Rosa, Jim R. Jones	The default baseline is the conservative scenario of bioenergy generation. Project proponents may choose alternative baseline scenarios including the one outlined by the commenters—feedstock decomposition in the field. In cases where the default scenario is not utilized, project proponents must	n/a

	Comment	Commenter	Response	Changes to Methodology
			provide sufficient evidence of non-bioenergy production baselines.	
4.5	The 'carbon-offsetting' logic of the methodology is perverse. In section 4.1, the document suggests that one of the possible alternative baseline situations is a biochar project that is already being implemented without "carbon offsetting". The additionality of these offsets is questionable. Switching from the ongoing status to the offsetting market would not result in any ERs and would attract criticisms on the environmental integrity of the project (McKibben, 2010). The entire concept of "offsetting" only applies in the early years of biochar project development. This is because offsetting can only apply if there is an existing fossil fuel emitter to offset against. Effectively, this means offsetting is a „once only" opportunity. Furthermore, the availability of biomass and fossil fuel users are not always geographically co-located, which further reduces the	Ruy K. Anaya de la Rosa, Jim R. Jones	The protocol follows international best practice for how it addresses the assessment of the baseline, the overall additionality of the project and the calculation of the offsets (Baseline minus Project emissions). Discussion on the appropriateness of offsetting as a mechanism is beyond the scope of this protocol and refers to the ACR system as a whole.	n/a

	Comment	Commenter	Response	Changes to Methodology
	opportunity to offset.			

5. Quantification of GHG Emission Reductions and Removals (KD)

	Comment	Commenter	Response	Changes to Methodology
5.1	Does the methodology account for heterogeneity in the pyrolysis method itself - in particular temperature used? Are there controls for the efficacy of the pyrolysis method/technology etc?	Sami Osman	The methodology relies on the IBI Biochar Standards to determine acceptability of biochar materials. The Standards do not prescribe any specific temperature ranges but do require re-testing of materials if the heat treatment temperature (HTT) varies by more than 10% from the original biochar material that was tested. In this sense, the methodology does account for consistency of temperature used in thermochemical conversion. The Standards are technology neutral and do not focus on other aspects of the pyrolysis process itself such as efficiency.	n/a
5.2	Does Winrock/ACR anticipate that it (or a partner) will be developing an Excel calculator for this protocol at some point in the near future?	Terrance Anthony	Yes, we are planning to develop an Excel calculator with an example before the Methodology is approved.	n/a
5.3	Please add Animal Waste as a separate category in Table 7 on page 33. Animal waste would not currently fall	Peter Thomas	Agree with making this change.	Added Animal Waste to Table 7

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	within any of the currently listed six Categories.			
5.4	Can someone (Keith?) provide an example with Emissions calculations for CO2 CH4 and N2O with test values, so we can get an idea of what that spreadsheet would actually look like?	Erin Rasmussen	Yes, see response to Comment 5.2	n/a
5.5	Where would biochar from algae grown to sequester smokestack CO2 fit in the model?	Rob Bartnik	Added to Table 7 Note: Feedstocks must ultimately be soil applied and not contain toxins, see IBI Biochar Standard for testing requirements.	Added Algae to Table 7
5.6	5. The baseline emission calculation should improve the methodological description. I understand that general idea but I think it is wrong the approach used it. As my point of view, the key word is “to displacement of baseline energy” instead	Miguel Cortes	See response to 3.9 from above.	n/a

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	of “to compensate for the heat produced in the project condition”. Why? Because the project developer should identify and justify what could be the equivalent energy that the project activity will displace on baseline scenario. There are others issues that should not be included in terms of conservative such as transportation or similar. 6. Agree to account the baseline methane emission by anaerobic decomposition but not agree with the competence or account the possibility that biomass by product could compete with baseline previous utilization as discussed above . This could generate or			

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	deforestation or promote at final stage the use of fossil fuels due to lack of biomass to supply baseline utilization. 7. The leakage calculation should include a methodological procedure to account the possibilities of displacement of baseline displacement or promote indirectly the use of fossil fuel in the supply chain. Hope this comments helps to IBI to improve the amazing idea. I would be happy to help with my experience on design and revision of CDM methodology process.			
5.7	In Table 7, it's not clear where agricultural waste feedstocks would be	John Swanson	See response to Comment 5.3	Added Crop Residue to Table 7

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	categorized.			
5.8	Regarding Equation 3, the analysis could be simplified if multiple feedstocks were quantified before being blended together, when possible.		Splitting out the equations by feedstock type supports verification of the carbon offset yield. In practice, the results of these equations are aggregated – such that the verifier can see the calculations for each stream in order to ensure they are handled appropriately.	n/a
5.9	The document does not properly differentiate between long-term CO2 removals and avoidance of greenhouse gas (GHG) emissions. When biomass is diverted from energy generation to biochar application into soils, a „carbon debt" may arise according to existing accounting procedures; that is, the biochar scenario might result in a net increase of GHG emissions, or the difference in emission reductions (ERs) could be low enough to discourage investment.	Ruy K. Anaya de la Rosa, Jim R. Jones	The protocol has been developed as inherently conservative. Further research and development work may illustrate additional pathways for GHG reductions. The protocol will be reviewed periodically to include these amendments when there is sufficient evidence to support.	n/a

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	If, however, sequestration was an accounting category, then biochar would always come out ahead. Comparative Life Cycle Assessments (LCA) on the uses of biomass could be undertaken to quantify this balance between sequestration and emissions.			
5.10	In section 4.1, the document states that "*Citing bioenergy as the default Baseline Scenario results in the exclusion of all electricity, heat, bio-oil, and biogas production, as well as a negation of all benefits of methane generation avoidance.*" This is not necessarily the case. Different pathways of bioenergy will likely deliver different services (e.g.	Ruy K. Anaya de la Rosa, Jim R. Jones	There is no doubt that significant LCA work around biochar will be useful for various purposes. At this stage, the approach proposed in the protocol is conservative.	n/a

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	heat and/or electricity production) at different magnitudes (e.g. GJ). The amount of energy provided by the biochar scenario through the combustion of syngas and bio-oil will be lower than the GJ supplied by the energy-only scenarios. Performing a comparative LCA would be pertinent to quantify the difference.			
5.11	The methodology tries to account for the difference in GHG emissions between the baseline (bioenergy) and the biochar scenarios by calculating carbon leakage in equation 34. This equation is incorrect for three reasons: 1) the product yields and the net calorific values of the products (syngas and	Ruy K. Anaya de la Rosa, Jim R. Jones	See response to 3.9 from above	n/a

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	bio-oil) are not included; 2) the conversion efficiencies of the devices burning these products are not considered; and 3) the net calorific value of the feedstock used in the baseline (bioenergy) scenario should be given on a fresh basis, i.e., as it is processed, and not in a dry basis as suggested otherwise the drying energy needs are not included. Typically, the feedstock generally needs to be dried to ~10% moisture content for pyrolysis, whereas the bioenergy facility may use feedstocks with higher moisture content. These factors should be reflected in the equation.			
5.12	In equation 4, the emission factors (EFs)	Ruy K. Anaya de la	Equations will be revised to include the appropriate GWP references when ACR authorizes these changes (ACR specifies	n/a

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	for methane and nitrous oxide have to be multiplied by the respective global warming potential (GWP) value. In addition, the GWP values proposed for CH4 (21) and N2O (310) derive from the IPCC‟s second assessment report (1995) and are therefore outdated. Moreover, some of the cited IPCC web links are not active.	Rosa, Jim R. Jones	to use SAR values at this time- http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html). These are the correct GWP values under ACR's requirements. These will change if ACR changes the requirement prior to the approval of this Methodology.) GWP values are set periodically. Links should be reviewed to ensure they are active. However, their accuracy over time cannot be guaranteed.	
5.13	The units of some of the parameters describing the equations 4, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 29, 30, 31 and 32 are not consistent.	Ruy K. Anaya de la Rosa, Jim R. Jones	Addressed	(4) Added GWP_{CH4} and GWP_{N2O} Added "(tCO2e)" to BE definition (18) (20)-(22), (24), (25) (27) –(32) kg changed to t (19), (26) kWh changed to MWh (19) – (22) Added "in year *y"* to BE

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				definition (23) Added "e" to (t CO_2e) in $PE_{TR,y}$ definition *(26), (29), (30)* Added*"* in year *y"* to PE definition
5.14	In section 5.3, the document states that "*Leakage due to the depletion of soil organic Carbon Stocks and the potential for overharvesting organic agricultural residue is addressed in Appendix 2*." Biomass residues left in soils provide nutrients and help to maintain soil structure. Therefore, overharvesting agricultural residues may require the additional use of fertilisers to compensate for the removal of nutrients formerly provided by	Ruy K. Anaya de la Rosa, Jim R. Jones	The commenters raise important points that merit clarification in the appendix. We have significantly expanded the appendix to clarify the process for demonstrating that feedstock procurement does not incur net negative impacts.	See A4.6

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	biomass. In the case of closed-loop systems, in which the biochar returns to the land where the biomass originated, this type of leakage may be avoided or minimised but this is not addressed anywhere in the methodology.			
5.15	The establishment of a buffer fund for biochar projects is recommended.	Ruy K. Anaya de la Rosa, Jim R. Jones	This is a non-AFOLU Methodology. 0nce the project is qualified and credited, the sequestration we quantify is permanent. Therefore there is no need for an additional buffer fund.	n/a
5.16	Sec5,5c what about Biochar as filtration? Why just for soil? Biochar in landfill serves same carbon sequestration purpose. Sec5c be wary of term soil amendment. It's taxable. We have qualified Biochar as specialty ag mineral which is not	Gregory Stangl	See response 2.1 above	n/a

6. Monitoring – (TK)

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6.1	Sec6.1 (p73). I think this should be a sliding scale. Or you should add more categories. Ours is 90%. Incent better production.	Gregory Stangl	(Commenter is referencing Fixed Carbon and Total C content in the BC+100 parameter) Incentivizing Biochar stability is our intent. As this industry matures, these criteria may be adjusted. The BC+100 is not based on the total C content but rather the molar ratio of H:Corg. If the molar ratio is <0.4, credit is awarded at 70% C content, and if it is <0.7 it is awarded at 50% C content.	n/a
6.2	What do you think the role of using precision consultants in the implementation of the Biochar protocol during reporting, verification and monitoring is?	Haben Asgedom	Consultants are welcome to be involved in Biochar projects. It is not the place of the Methodology to dictate how projects are implemented.	n/a
6.3	For Equations 4 and 5 on pages 56 and 57, the conversion multipliers for methane and nitrous oxide are reversed.	John Swanson	Thank you! Corrected	In Tables : Equation 4 and 5: In the “Any Comment:” section the conversion multipliers were corrected to: GWP for CH4 = 21, and GWP for N2O = 310, respectively.
6.4	The values, sources, and descriptions in Section 6 for the various terms in	John Swanson	Thanks for inspecting this.	n/a

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	the equations is very thorough and provides traceability and integrity to the methodology for calculating baseline and project emissions and carbon sinks.			
6.5	Since the methodology focuses on the production of biochar and not on the fate of biochar, there are no methods in place to monitor, report, and verify that a minimum fraction of biochar carbon will physically remain 100 years in the soils or in the ocean floor for that matter.	Ruy K. Anaya de la Rosa, Jim R. Jones	This is correct. The methodology developers believe that the biochar C stability test is sufficiently robust to confidently quantify the fraction of biochar C that will remain in the soil for the 100 year timeframe.	n/a
6.6	Once biochar is verified to be permanently stored in soil, no further monitoring or verification of that year's vintage is warranted. As the methodology is currently written, project proponents must file an annual monitoring report stating no variables have changed each year for seven years (see point 2 for our views on this subject). In addition, each time a project proponent seeks issuance of ERTs, third-party verification is required. This will include satisfying the chain of custody requirements indicating the biochar has been placed in soil or	L&C Carbon	This comment represents a misunderstanding of the coverage of the verification in each year. Under this protocol, the verifier will look at the biochar produced and included with soil during that year. The verifier will not be looking at previous years' results. Requirements for record keeping are governed by the ACR and not within the purview of the protocol developers.	n/a

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	mixed with another soil, compost, or amendment medium. 2 Issued ERTs therefore reflect carbon that has been permanently stored in soil. Once these ERTs have been verified (in year 1), requiring project proponents to re-verify those year-one claims in year five provides no additional enhancement or increases the environmental integrity of the original offset claims. This is a source of additional cost that will likely restrict participation in the program to only large scale biochar producers. For monitoring, we recommend the authors should limit the requirements to data retention over a two year period. For verification, we recommend the authors consider shortening the biochar project crediting period from seven years to four years or less. This change will eliminate the need for a re-verification at year five. The ACR Carbon Registry Standard allows for a shorter than seven year crediting period (see Chapter 3, page 17 - which states that the crediting			

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	period for projects will be seven years "*unless otherwise stated in the relevant ACR sector standard or approved methodology*").			
6.7	The proposed methodology requires the project proponent to track extensive data sources and report annually if there are any impact to the project's offset claims. This will be burdensome and costly for project proponents. The proposed methodology requires a project proponent to track the following information: • variables in the scientific literature; • emission factors and data from the UNFCCC & IPCCC; and • the most up to date version of the IBI Biochar Standards. Given the diverse number of formulas and variables, it would be difficult for project proponents to track all the potential changes in a given year. In addition, this could have an adverse impact on biochar project economics if the new data impacted the ERT calculations. This uncertainty around key project	L&C Carbon	Disagree. The methodology and factors utilized in the project plan should be in effect for the life of the project. The requirement to keep up to date with the relevant factors/variables is a requirement of any Methodology. This is a quick once per year check to ensure that the most relevant data is being used. This is an important part of ensuring that the offsets have rigor and validity. Yes, we plan to provide a calculation template.	n/a

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	variables could also have an adverse impact on investor interest in developing biochar projects. Thus, we suggest that major factors and variables are set at project initiation and remain constant through each crediting period, as per other accepted ACR carbon offset methodologies (see Columbia Carbon's IFM methodology for Non-federal forestlands, section B4 page 9). If things change in the interim years after project initiation, the project could be deemed ineligible for renewal at the end of the first or future crediting periods unless the methodology is updated to incorporate the new information. Factors, equations, and eligibility criteria change over time in most major carbon programs, protocols, and methodologies. For example, ACR is currently using "version 2.1" of their Carbon Registry Standard. We suggest that the authors take a similar approach with this biochar methodology. If new factors or variables are released by IBI or if the science of biochar changes with new			

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	findings published in the literature then the authors can incorporate these changes in a biochar methodology version 2.0. These new values will then apply to any new biochar projects without impacting existing projects. In addition, it would be helpful if the authors could provide an example ERT calculation sheet that illustrates how the key variables and equations function. In addition, we recommend that an ERT calculation template be included in the methodology that could be used by project proponents.			

7. References and Other Information

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Appendix 1: Standard test method for estimating Biochar carbon stability (DR)

	Comment	Commenter	Response	Changes to Methodology
A1.1	I have read your new draft standard, and find it most precise and thorough. The only thing that slightly worried me was the units	Dr. Beau Webber	Re units, all units are metric. Regarding a new molecular method to determine biochar carbon	n/a

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	conversion – are they from SI (metric) to American/Imperial or metric tons? This may be specified somewhere but I did not see it. My only other comment is regards later development of the standard, concerning the establishment of BC+100 : in the IBI document and yours: "BC+100 is determined fol lowing the calculation of H:Corg rat ios" This is indeed currently the most robust method of establishing BC+100, but as noted in the IBI report, there are Alpha and Alpha 2 methods that are or will be of interest in the future. I would just like to bring to your attention a method that was considered in the generation of the IBI report, but not included in the final document as it was so new that there was no published paper. This is the combined use of a couple of quick laboratory measurements, NMR relaxation (NMRR) and NMR cryoporometry (NMRC), to establish		stability, the methodology developers are tracking the evolution of science around biochar carbon stability. The technique mentioned by the commenter is intriguing but is not yet published in the peer reviewed literature and as such not vetted by the broader biochar science community. Future revisions to this methodology may update the biochar carbon stability test method to this or other techniques based on the latest science.	

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	the quantities of labile hydrocarbon in the biochar, and the physical structure of the biochar carbon skeleton, such that multi-scalar calculation might then be able to estimate the stable carbon lifetime directly. A paper has now been published (attached) that describes the study of biochar by NMRR and NMRC : 1. *An NMR study of porous rock and biochar containing organic material.* J. Beau W. Webber, Patrick Corbett, Kirk T. Semple, Uchenna Ogbonnaya, Wayne S. Teel, Carrie A. Masiello, Quentin J. Fisher, John J Valenza II, Yi-Qiao Song, Qinhong Hu. Proceedings of the 11th International Bologna Conference on Magnetic Resonance in Porous Media (MRPM11), University of Surrey, 2012. Microporous and Mesoporous Materials, 178, 94-98, 2013.			

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	DOI: 10.1016/j.micromeso.2013.04.004 As yet, the final step, the multi-scalar calculation to estimate the stable carbon lifetime has not yet been carried out – I am preparing a grant application in conjunction with Heriot-Watt university and Edinburgh university.			
A1.2	Why is the BC+100 not broken down more gradually according to the H/Corg values from 0.1 up to 0.7?	Thomas Rippel	Figure A2.9 shows that only a few biochars were found to exist with H/Corg <0.4. Between 0.4 and 0.7 on the other hand the lower limit of the 95% prediction interval is chosen for each 0.1 step in H/Corg. The reason for which only 0.4 or less was chosen to have a value of 70% and 0.4-0.7 a value of 50% was because the authors of the biochar carbon stability test—and of this methodology—sought to adhere to the conservativeness principle.	
A1.3	Doesn't the IBI 10% feedstock change requirement favor purpose grown crops, which are not allowed by the methodology? Doesn't this provide a disincentive to developers to use the most widely available feedstock in their	Kenny Key	The commenter is referring to the requirement that biochars be re-tested if there is a 10% change in feedstock composition under the IBI Biochar Standards. There is no inherent reason why this requirement should favor purpose	n/a

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	area at any given time? If the goal is to avoid purpose grown crops why not give project developers more flexibility?		grown feedstocks which would also need to undergo re-testing if the composition changed by more than 10%. While it does place some additional testing requirements on project proponents, this provision is necessary to ensure that the physicochemical properties of the biochar remain functionally the same as the biochar that is approved for use in the project.	
A1.4	The requirement to test the biochar produced every time the feedstock composition changes by more than 10% is overly onerous on project developers. In the draft methodology, the ACR refers to the current International Biochar Initiative (IBI) biochar standard concerning acceptable feedstock. In the IBI standard, certain feedstock is labeled as acceptable, with others being excluded, most notably purpose crown crops. However, the IBI also specifies how often biochar producers are allowed to change their feedstock and the percentage change they deem appropriate.	Interra Energy	The commenter is referring to the "material change" provision of the IBI Biochar Standards. The commenter is encouraged to review Tables A4.1 and A4.2 in Appendix 4 of the IBI Biochar Standards Version 1.1. Therein it is noted that the 10% change requirement is only applicable when there is a switch from one feedstock type to another—whether processed or unprocessed—as listed in the tables. Per the description of the feedstock used by Interra Energy, there would not be a need to re-test the feedstock material because it can all be classified as "biomass fraction of MSW" (processed feedstock),	

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	The IBI states that any change over 10% requires the producer to reanalyze the output biochar. The first issue is the specificity required when classifying feedstock. If the ACR will allow broad definitions, such as non-hazardous Municipal Solid Waste, then there is likely not an issue. However, if the definitions need to be specific, then it is likely that many producers will change feedstock by more than 10% often. For example, Interra plans to use source separated, residential and commercial landscape trimmings. These would likely fall under the MSW definition in the IBI biochar standard.2 However, within this definition the feedstock will change composition on a seasonal basis. If Interra were forced to re-test every time the composition changes, even though the feedstock is from the same source, it would be burdensome from a time and economic perspective. A clarification of feedstock definition specificity would be helpful.		regardless of differences in seasonality. Maintaining this 10% material change provision in the Standards is critical to providing assurances of biochar uniformity, particularly with respect to H/Corg and biochar carbon stability in this methodology. Increasing the threshold to 50% would create unacceptable levels of uncertainty about biochar carbon stability (and other properties of agronomic significance).	

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	If the ACR keeps the 10% requirement it will make it extremely difficult for biochar producers to cost effectively operate their systems. This is because the only way to guarantee a consistent feedstock supply is to pay for feedstock. For many producers, this cost can get prohibitively expensive and ruin the economics of operating a plant. In essence, instead of being able to buy the cheapest feedstock, or accept a plethora of cellulosic biomass greenwaste and perhaps charge tipping fees, these requirements force producers to enter into long-term feedstock contracts that hurt the financial viability of the project. Instead, there is a simpler way for the ACR and IBI to meet their goal of ensuring the quality of biochar and the stable carbon content. Instead of limiting the composition of feedstock, the methodology can list all acceptable feedstock with known biochar properties. So long as producers use feedstock from this list, in any combination or			

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	composition, the biochar well be deemed suitable for carbon offset purposes. This would make it easier for producers to source the best, and most economical, source of feedstock at any given time without having to go through unneeded bureaucratic steps. If this solution if not accepted, then Interra strongly encourages the ACR to adjust the percentage change of feedstock to over 50% prior to requiring further testing. This will reduce the burden on project developers and biochar producers to find a single source of feedstock. Alternatively, the methodology can require producers to take a random sample every month for testing, rather than having to test every time the composition changes over the 10% threshold. It was stated in the methodology webinar, by Keith Driver that so long as producers specify all of their feedstock types when submitting a project, then only a 10% change from that initial list			

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	would trigger further testing. However, this is not made clear in the methodology or the IBI standard. If that is the case, Interra would encourage the methodology to be more straightforward so that developers will know the proper requirements. Biochar producers are just as concerned with biochar quality and stable carbon. However, Interra recognizes there is a plethora of studies on multiple feedstock allowing the methodology to be more broadly applicable without such restrictive requirements. Further, developers have a better idea of project economics and financial realities and would hate to see a methodology that is unworkable in practice. For instance, if producers had to pay more for feedstock in order to qualify for offsets they may decide not to pursue offsets unless the offset price was more than the increased feedstock price. These downstream effects need to be fully considered.			

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A1.5	The chain of custody requirement is unduly burdensome on developers. In the methodology, developers are required to show a chain of custody for feedstock materials. This is supposed to ensure that the feedstock is not sourced from purpose grown crops and as a means to monitor the land use change associated with the feedstock. However, this requirement creates an added burden to developers that is unnecessary. The concerns can be more easily resolved by requiring project developers to verify in writing that their feedstock is sourced from approved materials with the penalty being forfeiture of the offsets plus monetary damages. This penalty provision, along with random inspections, would deter developers from sourcing unwanted feedstock. The current requirements places on burden on developers, many who are dealing with unsophisticated parties, to adequately document all of the feedstock sourced.	Interra Energy	The chain of custody (CoC) requirements in this methodology are embedded in the IBI Biochar Standards. The CoC requirements are intended to provide assurances of feedstock provenance. Written statements by project proponents leave room for abuse of feedstock sourcing requirements. Random inspections could help mitigate this risk but inspections would be resource intensive. IBI does not have the resources to conduct in-person audits at this stage so has chosen to take the route of requiring detailed CoC information. IBI recognizes that CoC traceability can be complex in long supply chains and is working with biochar producers to add flexibility into the CoC requirements that maintain assurances around feedstock sourcing.	n/a

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	Interra would encourage a rethinking of this requirement to find an easier way to ensure feedstock meets the requirements of the methodology.			
A1.6	The estimates of carbon stability seem fair, but should be revisited upon further study. The methodology walks the fine line between biochar advocates and biochar skeptics. The carbon stability estimates are very conservative, but offer a bright line rule for producers to follow. Interra would encourage the ACR to continue to review the literature and studies onto the carbon stability of biochar and adjust the estimates in the methodology accordingly as the estimates become more refined.	Enterra Energy	SJ- We agree fully with the commenters on this point. It is the intent of the methodology developers to stay abreast of developments in biochar stability science and make revisions to the stability test method as scientific consensus on improved methods emerges.	n/a
A1.7	Biofuelwatch has been closely following and critically assessing scientific findings and policy developments related to biochar since 2008. We consider that the most significant flaw in the proposed	Biofuelwatch	See external document (BFW comment_IBI 21Feb2014)	n/a

	Comment	Commenter	Response	Changes to Methodology
	methodology is the assumption that soil carbons sequestration through biochar can be predicted according to the International Biochar Initiative's Standard Test Method for Estimating Biochar Carbon Stability and that therefore regular (e.g. annual) testing of representative soil samples from fields treated with biochar should not be required. This assumption is based largely on the hypothesis that the fate of organic carbon can be predicted by its molecular properties, through laboratory tests. This hypothesis has not been proven through field trials in the case of biochar and it is contradicted by recent soil science findings. A 2011 scientific review by 14 authors (one of them the Chair of the Board of the International Biochar Initiative, Johannes Lehmann) refutes this hypothesis. The article, Persistence of Soil Organic Matter as an Ecosystems Property, Michael W.I. Schmidt et al, Nature, 6th October 2011,			

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	summarises recent soil science findings as proving that "*the persistence of soil organic carbon is primarily not a molecular property, but an ecosystem property".* This means that the actual stability of soil carbon depends largely on ecosystems functions, such as soil types and properties, climate, microbial diversity and distribution, etc. The article explains: *"The molecular structure of biomass and organic material has long been thought to determine long-term decomposition rates in the mineral soil. However, using compound-specific isotopic analysis, molecules predicted to persist in soils (such as lignins or plant lipids) have been shown to turn over more rapidly than the bulk of the organic matter. Furthermore, other potentially labile compounds, such as sugars, can persist not for weeks but for decades. We therefore cannot extrapolate the initial stages of litter decomposition to explain the persistence of organic compounds*			

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	in soils for centuries to millennia—other mechanisms protect against decomposition. Perhaps certain compounds require cometabolism with another (missing) compound, or microenvironmental conditions restrict the access (or activity) of decomposer enzymes (for example, hydrophobicity, soil acidity, or sorption to surfaces18).” The authors make it clear that those findings also apply to black carbon (biochar): “*[Black carbon] is not inert, but its decomposition pathways remain a mystery. Fire-derived carbon was suspected to be more stable in soil than other organic matter because of its fused aromatic ring structures and the old radiocarbon ages of fire residues isolated from soil. However, fire-derived carbon does undergo oxidation and transport, as we now know from archaeological settings, soils and from breakdown products in river and ocean water. In a field experiment, fire-derived residues were even observed to decompose faster than the remaining bulk*			

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	organic matter, with 25%lost over 100 years (ref. 29). Spectroscopic characterization shows that combustion temperature affects the degree of aromaticity and the size of aromatic sheets, which in turn determine short-term mineralization rates… *Certain types of biochar can degrade relatively rapidly in some soils, probably depending on the conditions under which they were produced, which suggests that pyrolysis could be optimized to generate a more stable biochar. But as with natural fire residues, persistence over the long term may also be affected by interaction eiyh minerals and by soil conditions (for microorganisms capable of char oxidation and for abiotic oxidation). Whether interactions of fire derived carbon with soil minerals may be manipulated to enhance stability, and what the trade-offs might be with fertility benefits, are not known*." Another soil science review comes to similar conclusions: Soil organic			

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	matter turnover is governed by accessibility not recalcitrance, Jennifer A.J. Dungait et al, Global Change Biology, 2012. The authors also point out that testing for 'carbon recalcitrance' in a laboratory cannot accurately predict the fate of different types of soil carbon: "*An apparently obvious method to increase C stocks in soils is to augment the soil C pools with the longest mean residence times (MRT). Computer simulation models of soil C dynamics, e.g. RothC and Century, partition these refractory constituents into slow and passive pools with MRTs of centuries to millennia…However, contemporary analytical approaches suggest that the chemical composition of these pools is not necessarily predictable because, despite considerable progress with understanding decomposition processes and the role of decomposer organisms, along with refinements in simulation models, little progress has been made in reconciling*			

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	biochemical properties with the kinetically defined pools." According to this article, the main factors that control all soil carbon decomposition are substrate quality, soil organisms and their enzymatic repertoire and environmental conditions – not the apparent 'recalcitrance' of soil carbon that can be determined in a laboratory. The article specifically discusses the implications for biomass-derived black carbon (biochar): "*Biomass-derived black C comprises a substantial component (5–50%) of organic C in some soils, and is assumed to decompose at a much slower rate than SOM due to its highly condensed aromatic structure (Schmidt et al., 2001). Large charcoal particles originating from forest wildfires can remain in soils for thousands of years (Major et al., 2010), although smaller particles derived from grassland burning can hardly be detected in steppe and prairie soils (Forbes et al., 2006). Lehmann et al. (2006) suggested that conversion of biomass C to biochar leads to*			

	Comment	Commenter	Response	Changes to Methodology
	sequestration of about 50% of the initial C yielding more stable soil C than burning or direct land application of biomass. However, biochar can be used as a substrate by soil microorganisms (Wengel et al., 2006) and is therefore not completely inert…After application to soils, biochar decomposition rates vary under different soil conditions, e.g. water regime (Nguyen & Lehmann, 2009), native SOM concentrations (Kimetu & Lehmann, 2010) and pH (Luo et al., 2011)…Overall, the use of biochar as a robust strategy to increase soil C stocks as described by Lovelock (2009) requires additional investigation." These articles and the sources cited in them clearly show that the key hypothesis on which this methodology rests (i.e. that soil carbon stability can be predicted from laboratory analysis without a need for ongoing soil testing) is strongly disputed by the findings of leading soil scientists. There have been very few peer-			

	Comment	Commenter	Response	Changes to Methodology
	reviewed field trials that look at the biochar impacts on soil carbon even over a short period of up to four years. Biofuelwatch conducted a review of all peer-reviewed biochar field studies published by mid-2011. At that time, we found only five such studies that looked at soil carbon impacts. Those five studies together included 11 different soil/vegetation scenarios. Out of those 11 'samples', no net carbon sequestration was found at the end of the trial – i.e. plots to which carbon-rich biochar had been added showed no increased overall soil carbon levels when the trials were concluded (excluding an unrealistically high rate of 116.1 tonnes/hectare in one such trial). In one of those five samples, biochar additions were even linked to a temporary net carbon-loss. In three other samples, biochar did result in higher total soil carbon for the short duration of the trials when compared to largely unamended soils, but it did not result in higher total soil carbon			

	Comment	Commenter	Response	Changes to Methodology
	than common alternative soil amendments that were tested at the same time. Biochar only resulted in (short-term) net carbon sequestration compared to common soil amendments that were tested in 3 out of 11 samples. There has been a continuing lack of field trials that study biochar soil carbon impacts since then. This means that the key hypothesis on which this draft methodology rests is not backed by empirical evidence – indeed it is contradicted by the small volume of empirical evidence that does exist. The full references for and details of the studies can be found in our Chapter 3 of our report Biochar: A Critical Review of Science and Policy, http://www.biofuelwatch.org.uk/wp-content/uploads/Biochar-Report3.pdf. Even a recent incubation, rather than field study, confirms that the 'stability' of the carbon from the same type of biochar is heavily affected by different soil properties and that biochars predicted to			

	Comment	Commenter	Response	Changes to Methodology
	remain 'stable' in one soil for many centuries would be decomposed within a few decades in other soil samples: Biochar carbon stability in four contrasting soils, Y Fang et al, European Journal of Soil Science, 2013. Annex 2 of the draft Methodology acknowledges biochar carbon may not remain in soils but argues that even if it lost from soils, it should be assumed that it would nonetheless be sequestered long-term elsewhere: "*The physical movement of Biochar away from the point of soil application appears to occur at a similar rate to or possibly faster than for other organic carbon in soil (Rumpel et al., 2005; Guggenberger et al., 2008; Major et al., 2010b). Eroded Biochar C is considered to remain sequestered as it is typically buried in lower horizons of soil or in lake or ocean sediments (France-Lanord and Derry, 1997; Galy et al., 2007; Van Oost et al., 2007).*" It seems astonishing to us that a			

	Comment	Commenter	Response	Changes to Methodology
	proposed soil carbon methodology would say that the carbon my not remain sequestered in soils but that it should simply be assumed that it is then sequestered elsewhere, including in ocean sediments. There is no doubt that a considerable proportion of black carbon (most of it black carbon from wildfires) is regularly transported to lake or ocean sediments and that it can remain there for very long periods. But there is no evidence that all black carbon transported from soils is sequestered elsewhere rather than being decomposed biotically or abiotically. To the contrary: Researchers who have looked at the global black carbon budget have found that the overall amount of black carbon sequestered in marine in freshwater sediments and in soils combined is far smaller than it would be if the black carbon produced annually was as recalcitrant as many assume it to be. A 2004 study (New Directions			

	Comment	Commenter	Response	Changes to Methodology
	in Black Carbon Organic Chemistry, C.A. Masiello, Marine Chemistry 92, 2004) highlights those discrepancies: *"Measurements of BC production and loss processes are not balanced… The lower end of the BC production rate, 0.05 Gt/year, would mean that BC was 30% of sedimentary organic carbon and although it is possible that this could be the case in some abyssal sediments, the vast majority of sedimentary organic carbon is stored in deltas, shelves, and slopes (Hedges and Keil, 1995). Measurements of BC in these regions suggest that BC is only 3–10% of sedimentary organic carbon (Table 1)… If BC has been produced since the last glacial maximum via biomass burning at the same rate as it is now produced, BC should account for 25– 125% of the total soil organic carbon pool (Masiello and Druffel, 2003). Although a few measurements of soil BC/SOC are as large as 25%, even this lower bound is unrealistic for the entire soil carbon pool. Some of this BC*			

	Comment	Commenter	Response	Changes to Methodology
	may be lost to erosion, but as Dickens et al. (2004) have shown that less is stored in sediments, erosion cannot solve this BC pool size problem (Schmidt, 2004)… even a labile BC loss process with a timescale of thousands of years is too slow to account for environmental observations." We are not aware of any recent scientific discovery that would change this conclusion, nor of any stud that 'balances' the global black carbon budget by using the International Biochar Initiative's assumptions about carbon stability. The second hypothesis on which the methodology is based, closely coupled to the first, is that negative priming is assumed to exceed positive priming – another argument used to justify the lack of proposed soil carbon measurements. 'Priming' refers to the effect which the addition of new soil carbon has on existing soil carbon pools. 'Positive priming' means that adding new sources of carbon results in an accelerated			

	Comment	Commenter	Response	Changes to Methodology
	decomposition of existing soil carbon. 'Negative priming' means the opposite, i.e. that adding a new source of carbon results in existing soil carbon pools becoming more stable. Net carbon sequestration does not just depend on the added biochar carbon remaining stable, but on the overall soil carbon pool being increased. Biochar studies – mostly laboratory ones – show that biochar additions can cause either positive or negative priming. The authors of the draft Methodology cite a single peer-reviewed study as evidence that negative priming can be assumed for outweigh positive priming: Modelling the long-term response to positive and negative priming of soil organic carbon by black carbon, Dominic Woolf and Johannes Lehmann, Biogeochemistry 2012. We believe that it is wholly inappropriate to cite this single article as 'conclusive evidence'. As the title suggests, this is a modelling study, not a biochar trial, nor review of data gained from field trials. It relies on a version of the RothC soil carbon			

	Comment	Commenter	Response	Changes to Methodology
	model, a model which relies on predicting the fate of soil carbon from its chemical structures and properties, i.e. on defining 'recalcitrance' from incubation studies. This is precisely the approach which, as the two soil science reviews discussed above (one of which had Johannes Lehmann as a co-author) show, do not reflect current soil science knowledge and cannot adequately predict the fate of soil carbon. The article by Dominic Woolf and Johannes Lehmann cited in the draft Methodology cautions: "*Given the paucity and variability of existing data on priming effects by BC, together with the challenges inherent in extrapolating from short-term laboratory incubations to long-term effects in a natural environment, some caution needs to be exercised in how these results should be interpreted… It is clear from this modeling study that an improved understanding of the mechanisms underlying SOC stabilization should be a research priority in determining how*			

	Comment	Commenter	Response	Changes to Methodology
	incorporation of BC into soil would impact long-term npSOC levels." In other words, the authors admit that there is a scarcity of actual data on biochar priming effects and that more research is needed. Overall, it seems remarkable that the authors of the draft Methodology would argue that a single modelling study, using a model which has been strongly criticised, including in an article published in Nature to which one of the authors of the modelling study had contributed, justifies carbon offsets for biochar in the absence of regular soil carbon measurements. We therefore hope that the currently proposed methodology will not be accepted.			

Appendix 2: Justification for the "Standard test method for estimating Biochar carbon stability (DR)

	Comment	Commenter	Response	Changes to Methodology
A2.1	What is the time to do the alpha test? What is an estimated cost of an alpha test? How often does this need	Jerry Scharf	The biochar carbon stability test (BC+100) is conducted by accredited third party testing laboratories. The	n/a

	Comment	Commenter	Response	Changes to Methodology
	to be done for a biochar stream (assuming a mix of woody slash feedstock)?		test is a routine laboratory test to determine the molar ratio of hydrogen and organic carbon in the biochar material. Turnaround times for testing by labs will vary but can likely be done on the order of days to weeks. The cost for this test is estimated to range from $50-200. The biochar needs to be tested on an annual basis, assuming the feedstock composition remains the same from year to year. If material changes of 10% or more occur to feedstock during that 12-month period, re-testing is required, since it is will produced a different biochar, with different properties.	
A2.2	The 0.5 I believe had a low point of 62% stability and a High around the 70% areas. If we attribute 50% only to this then people will not have a reason to implement advances that bring their quality up from lower quality 0.6 and 0.7. Without some kind of recognition, people will have no reason to improve a 0.7 quality to a 0.5., and will continue with the less quality option. So, will this be re-evaluated at some time?	Dilmum Dombro	These limits were developed by the expert panel, with the express desire to incorporate conservativeness into the calculations. Refer to A1.2.	n/a

	Comment	Commenter	Response	Changes to Methodology
A2.3	Can an expert explain why the drop for the stable Biochar was chosen to drop so strongly from H/C ratio 0.4 to 0.5 and then remains flat from 0.5 to 0.7?	Roderick Tanzer	See A2.2	n/a
A2.4	How did you decide that biochar is relatively inert once it's applied to soil? There's a large range of stability estimates in the literature, and very few studies have been done in the field. The current draft document states that an H:Corg ratio < 0.7 is based on laboratory data & therefore is conservative, but wouldn't it be the opposite because lab studies are in a controlled environment, but in the field so many other elements are in play & therefore there's less certainty that the H:Corg ratio is an indicator of stability?	Patricia Elias	The laboratory incubation studies used to develop the BC+100 test were conducted under diverse and harsh conditions – harsher than those expected to be experienced in the field. First, incubations were done at temperatures of 22C and 32C in the two studies. Global mean temperatures are much lower (typically under 10C) so biochar placed in soils can be expected to experience lower temperatures. Because temperature dictates microbial activity, the rate of biochar degradation attributable to microbes can be expected to be much lower. Second, moisture and nutrient constraints under field conditions also lower microbial activity and thus the rate of biochar degradation. Both incubation studies were conducted in different	n/a

	Comment	Commenter	Response	Changes to Methodology
			aqueous solutions so water availability was not a constraint.. Further, various inoculants and microbes that increase degradation were also added. Please see Appendix 2 and the response to commenter Noel Gurwick for further details.	
A2.5	The justification for the use of the standard test method for estimating biochar carbon stability is persuasive and clearly establishes the basis for using biochar projects as offsets.	John Swanson	Agreed.	n/a
A2.6	Thank you for the opportunity to comment on your methodology for biochar projects. Climate change mitigation is critical for human well being, and carbon markets like the one established in California by AB32 offer a promising approach to achieving that mitigation. These environmental markets rely on offsets to operate efficiently, and there is as a result a strong need for credible, robust methodologies to support project development and market transactions. The American Carbon Registry is playing an important role in developing those	Noel Gurwick	See external document (NGurwick comment_IBI 21Feb2014)	n/a

	Comment	Commenter	Response	Changes to Methodology
	methodologies. Although many variables need to be considered to establish the influence of biochar amendments to soil on net greenhouse gas emissions, one critical variable is the stability of the biochar. Recent years have seen many statements that assume biochar persists for hundreds to thousands of years in soil, which could lead to efforts to quantify biochar stability in particular projects, as the ACR methodology does. I recently led a systematic analysis of the literature that describes biochar stability, published in PLoS One, appended to these comments (Gurwick et al., 2013). This close examination of the literature revealed that there are very few studies that have attempted to measure biochar stability under the field conditions that would be relevant if biochar projects were actually deployed in a carbon market. In our review of over 300 peer-reviewed publications, all reporting original research on biochar, we found only seven that			

	Comment	Commenter	Response	Changes to Methodology
	estimated biochar stability under field conditions. A critical piece of supporting evidence in the methodology is Table A2-1. This table contains estimates of biochar stability, but whereas the methodology would reward projects that apply biochar under field conditions, this table is a mix of laboratory and field studies, and it fails to include all of the field studies available – which are both few in number and, as we argue in our paper, the most important studies to consider. For example, in Table A2-1, Kuzyakov et al. (2009) is listed as reporting a mean residence time (MRT) of 2,000 years, but it is a laboratory study. The table fails to include, for example, Bird et al. 1998, a field study that found an estimated mean residence time of less than 50 years. Table 1 from Gurwick et al. (2013) lists all the field studies we could identify published through December 2011, and suggests a wide range of times over which biochar persists, from 8.3 to over 3,000 years with studies distributed relatively			

	Comment	Commenter	Response	Changes to Methodology
	evenly over this range. As we wrote: very few data are available to evaluate the stability of biochar in situ. Only seven of the primary research papers we identified reported field investigations of biochar stability in soil, and their estimates of stability – although not easily and directly comparable – spanned three orders of magnitude, from years to millennia (Table 1). Moreover, only one of those studies quantified the uncertainty of the results…. Two studies calculated mean residence time via first-order decay models but did not discuss the uncertainty in the calculations [48,49]. Other researchers noted ‘‘comparatively large’’ uncertainties [50,51] and numerous investigators have cautioned that stability must be better understood [52–55]. The distinction between field and laboratory studies cannot be overstated. Numerous biological and physical processes in the field influence stabilization and destabilization of many forms of			

	Comment	Commenter	Response	Changes to Methodology
	organic matter. The DRAFT ACR methodology asserts that: "Because [lab experiments] are closed systems and non-variant conditions, estimates of stability based on these measurements can be considered conservative." I urge you to reconsider that statement, as it is not scientifically defensible. Decomposition rates could easily be slower in a laboratory experiment than under field conditions owing to presence or absence of different fungal communities or plants, different physical conditions, and a host of other factors. Laboratory experiments are very helpful in forming hypotheses and identifying key experiments to deploy in the field – investigations that take longer and require substantially more resources than laboratory-based studies. But laboratory studies cannot provide the level of confidence needed to estimate biochar stability for inclusion in a carbon market, a situation in which adding biochar to soil under field conditions would enable the release from regulated			

	Comment	Commenter	Response	Changes to Methodology
	sources of CO2 that would otherwise be disallowed. In addition, biochar production results in a short-term pulse of CO2 to the atmosphere, a pulse of CO2 that leads to near-term acceleration of climate change. This climate "cost" needs to be taken into account when evaluating the net influence of biochar production and application to soils in the field. Similarly, biochar influence on nitrous oxide emissions from soil are very poorly understood, as is the influence of biochar on decomposition of native soil organic matter. As noted above, when we look at field-based estimates of biochar stability we find few studies and a wide range of estimates among those studies. We asked: "What might account for the wide variation in field-based estimates of biochar stability?" We found (boldface added): These field experiments were conducted in a variety of ecosystems			

	Comment	Commenter	Response	Changes to Methodology
	on several continents, leading to large variation in conditions such as temperature, moisture and microbial communities, all of which act on the biochar in each study (Table 1). The experiments also used different biochar feedstocks and pyrolysis conditions such as temperature, duration, and oxygen content, all of which affect biochar properties and hence stability [11]. Production methods included vegetation fires, historical kilns, carefully regulated commercial or laboratory reactor vessels, and simply piling biomass on top of a burning chamber and waiting for the pile to turn black. This variation in experimental materials and conditions is a valuable feature of fieldbased studies of biochar. After all, biochar systems would be implemented in different ecosystems using a greater variety of biochars and methods than were reported in the seven field studies we identified. Similarly, the potential diversity of feedstocks and conditions that could be used is greater than represented in these			

	Comment	Commenter	Response	Changes to Methodology
	field studies, as evidenced by the broader range of experimental conditions represented in the 311 primary research articles included in our review. For example, biochar feedstock could include animal waste [61,62], agricultural waste [63,64], and natural vegetation [65,66]. **Studies to date begin to establish the range of variation in biochar stability but do not go very far towards explaining it.** As this young field begins to mature, field-based studies conducted across sites that vary systematically with respect to key variables such as temperature and moisture, and that span the full range of variation, combined with laboratory experiments, should help establish empirical understanding of why biochar stability ranges so widely and project how biochar might behave in a given setting [67]. As we conclude in our peer-reviewed paper: • The study of biochar behavior in soil is a very young field, as reflected in diverse, nonstandardized terminology			

	Comment	Commenter	Response	Changes to Methodology
	and methods, and uneven distribution of studies across topic areas. • We lack the field studies that are needed to understand with confidence how biochar production and application affects whole-system GHG balance. Key variables include, for example, emissions associated with biochar production, transportation, and application to soils; the extent to which biochar amendment stimulates ("primes") decomposition of soil organic matter; the influence of biochar on non-CO2 trace gas emissions; and the amount of energy captured during biochar production. • Even with limited available data, it is evident that potential long-term benefits of biocharbased carbon sequestration come at a cost of short-term CO2 pulses into the atmosphere and, consequently, near-term acceleration of climate change. • Optimistic claims about biochar's			

	Comment	Commenter	Response	Changes to Methodology
	benefits to the environment contrast sharply with the limited amount of research on biochar's behavior and effects. There is insufficient empirical evidence to support assertions that biochar amendment to soil mitigates climate change significantly, or that it provides overall environmental benefits when evaluated across a comprehensive set of metrics. We need a systematic field research program that investigates stability of biochars representing a range of feedstocks and production methods, across climate and soil gradients. But the necessary research has not yet been conducted. **While there is always a need for caution when research scientists suggest that "more research is needed," in this case – and particularly in the context of a carbon market which requires a very high degree of confidence in offsets – science conducted to date simply is not sufficient to support a biochar protocol, no matter how elegantly**			

	Comment	Commenter	Response	Changes to Methodology
	constructed. The American Carbon Registry has exercised, and continues to show, much needed leadership in the development of carbon markets and offsets, but the adoption of this or any biochar protocol at this time would be a mistake because sufficient knowledge of how fast biochar decomposes simply does not yet exist. Biochar may have many positive attributes for the environment and human well being, but its carbon sequestration potential cannot at present be quantified at the level needed for an offset protocol. The science is simply too young to justify its inclusion in a carbon market, and attempting to do so risks undermining the credibility of many robust protocols that have been developed. I hope ACR will reconsider the viability of a biochar methodology and direct its excellent resources towards development of protocols where the science is more mature.			

Appendix 3: Priming of SOC mineralization by black carbon

	Comment	Commenter	Response	Changes to Methodology
A3.1	***SOC impact of removing biomass residues from forest/land seems not to be explicitly considered.*** While priming[3] is an impact that occurs after admission of a new substrate the biochar has been admitted to, the 'biochar methodology' does not seem to explicitly address SOC impacts in cases when the baseline scenario either is aerobic or anaerobic decomposition and where some level of naturally occurring C-storage impact is also avoided. Even though scientific evidence suggests this impact is insignificant for longer time-spans (≈1% of unpyrolysed organic matter added to soil this year will still be in the soil after 100 yrs), there might be some noticeable impact levels during the (generally shorter) CO_2-crediting period (e.g. 10 to 20 years). Based upon the above, this issue could be addressed	The consortium partners of the project: INTERREG IVb North Sea Region, "Biochar: climate saving soils", led by the lead partner the Province of Groningen, the Netherlands, represented by the project manager F. Debets (fransdebets @debetsbv.nl)	The commenter makes a good point about biochar's priming effect—positive or negative—as well as the SOC stabilization that may be avoided if the feedstock in the baseline scenario is diverted from situations where it may have been incorporated into the soil and thereby stabilized/added to the SOC content. There is emerging evidence that biochar itself in most situations stabilizes native SOC over the long-term i.e. has a negative priming effect. However, for conservativeness we have decided to exclude any negative priming effects from this methodology and to include a 5% discount factor for hypothetical positive priming. While there may be short-term increases in SOC under the baseline feedstock use scenario, those increases are likely at least an order of magnitude less than increases from biochar addition under the project scenario.	n/a

[3] Appendix 3 of the Biochar Carbon Offset Methodology

	Comment	Commenter	Response	Changes to Methodology
	methodologically, either by acknowledging that this impact is only relevant for specific classes/types of feedstock or by declaring (based upon scientific evidence) that this impact is insignificant, or by introducing a relevant science-based C-storage discount factor.			

Appendix 4: Sustainable Feedstock Criteria (TK)

	Comment	Commenter	Response	Changes to Methodology
A4.1	By "qualified sustainable feedstock" is that similar to "virgin" biomass?	Jay Wise	No. The feedstock sustainability criteria described in Appendix 4 do not specifically relate to “virgin” biomass. Rather they are designed to mitigate negative environmental impacts associated with soil carbon loss, erosion, etc. rather than addressing specifically feedstock type. Assuming the commenter means primary forest (a common use of the term “virgin”), there is no requirement that the biomass feedstock be “virgin”. Rather, there are requirements in the IBI Biochar Standards that relate to both processed and unprocessed feedstocks, and in the Appendix that require documentation of no net negative environmental impacts.	n/a

	Comment	Commenter	Response	Changes to Methodology
A4.2	If the feedstock will change during the 7 year crediting period, will a separate sustainability criteria evaluation be required whenever the feedstock changes?	Kenny Key	Yes. If the feedstock changes during the crediting period the project proponent will have to submit a new feedstock sustainability evaluation. A "material change" in feedstock is described in Appendix 4 of Version 1.1 of the IBI Biochar Standards.	n/a
A4.3	The sustainability criteria are necessary, but should also include a detailed focus on the co-benefits of biochar production in a given region. The methodology correctly looks into key sustainability criteria associated with biochar production. Interra recognized that rural communities have been some of the hardest hit economies in the past five years. The ACR would serve these communities well by encouraging the implementation of technologies that can provide an added revenue stream and fit seamlessly into current agricultural operations in rural communities. Interra's biochar technology offers a way for agricultural businesses to turn a waste product that they typically have to pay to dispose of into two viable products (biochar and	Interra Energy	We agree with the commenter regarding the multiple potential co-benefits of biochar systems. The focus of the feedstock sustainability criteria, however, is exclusively on mitigating any negative environmental impacts associated with feedstock procurement for biochar production. This is because of known issues in related industries, for example, land use change associated with oil palm for biofuels production. Because feedstocks for biochar may have competing uses, both for human and natural communities, it is critical to ensure that this methodology does not provide incentives that lead to detrimental ecological or social impacts. While the quantification of other co-benefits of biochar systems would lend credence to their validity it is beyond the scope of this methodology.	n/a

	Comment	Commenter	Response	Changes to Methodology
	biomethane gas). Moreover, the technology will help reduce emissions in the region and will help improve the regions soils. The co-benefits associated with Interra's technology are not explicitly included in the current sustainability criteria. First, the technology will help divert waste and organics from landfills and reduce the fees associated with disposing of waste. Second, implementing and operating the technology will create high paying, high skill, and domestic jobs. Third, the technology can create an added revenue source for large-scale agriculture facilities (similar to revenues gained from siting wind turbines on their land) or government run landfills. Another important advantage for the California market it that the technology has the potential to generate water, or at least be water neutral. One of the outputs of Interra's technology is water. A majority of this water will be recycled within the system for			

	Comment	Commenter	Response	Changes to Methodology
	cooling needs and as a water shower to clean up the gas prior to exit. Once this water has been recycled in the system it can be purified, using biochar as a filtration device, and exported to other onsite uses such as plant and vegetation watering, irrigation, or for sanitation needs. As California is facing a water shortage, it will be crucial for new energy technologies to find ways to reduce their water use. Besides the environmental benefits mentioned above, biochar has many economic benefits in the agricultural sector (e.g. increasing soil fertility, nutrient retention, and water retention) and the water and air purification industries (e.g. creating a cheap and environmentally friendly alternative to fossil fuel derived activate carbon). These co-benefits of biochar systems should be included in the sustainability criteria.			
A4.4	The appendix for sustainable feedstock criteria establishes a 25% limit for residues that must be left in	John Swanson	The commenter raises a good point. Ultimately, the feedstock sustainability requirements aim to ensure that no detrimental environmental and	Removed references to a requirement to

	Comment	Commenter	Response	Changes to Methodology
	place for forestry and agricultural feedstocks to replenish soil nutrients. If a reference for the basis of this criterion exists, it would add credibility to include it in the posited sustainable feedstock approach.		social impacts occur as a result of feedstock procurement. The requirement to retain 25% of residues in place has been removed and replaced with more comprehensive and robust monitoring and evaluation criteria to ensure feedstock sustainability.	retain 25% of residues in place.
A4.5	There are several valid certification systems that are designed to verify the sustainable management of forest resources. The Forest Stewardship Council is just one credible and widely recognized scheme. There are two additional credible and widely recognized certification programs operating across the United States - the American Tree Farm System and the Sustainable Forestry Initiative. All three of these programs are currently recognized in other major carbon protocols and methodologies (including the California Air Resources Board, the Climate Action Reserve, and the American Carbon Registry). We suggest that the authors expand the acceptable forest certification systems to include all three programs.	L&C Carbon	We agree that ATFS and SFI should be included as two additional forest certifications programs that are widely accepted by other carbon offset registries—including ARB, CAR, and ACR—as demonstrating sustainable forest management practices. The commenters further raise an important point about public lands not participating in certification programs. Adopting language similar to that used by ARB is a useful suggestion.	SFI and ATFS have been added as accepted forestry certification programs. Further, the scope of acceptable evidence for sustainable forest management has been expanded to permit the use of feedstocks from publically managed forests.

	Comment	Commenter	Response	Changes to Methodology
	In addition, public land agencies (state and federal) do not typically participate in forest certification programs. Since forest residues for producing biochar could potentially be sourced from these lands, we propose the following to demonstrate forestry feedstocks are sourced from lands following long-term harvesting practices (adopted from ARB COP U.S. Forest Projects—section 3.8.1, page 18). http://www.arb.ca.gov/regact/2010/capandtrade10/copusforest.pdf "The Project proponent must demonstrate the forest feedstocks are sourced from lands that are practicing sustainable long-term harvesting approaches, using one of the following options: 1. The Forest Owner must be certified under the Forest Stewardship Council, Sustainable Forestry Initiative, or American Tree Farm System certification programs. 2. The Forest Owner must adhere to a renewable long-term management			

	Comment	Commenter	Response	Changes to Methodology
	plan that demonstrates harvest levels which can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency."			
A4.6	The current wording on demonstration of "no net negative impacts" from diverting forest residues is ambiguous and should be clarified (Appendix 4, page 133). Providing more information or a list of criteria that the project proponent can follow and that the verifier can compare against would be helpful. For example, if the forest feedstocks are logging residues from state forest lands and the common practice is burning the piles in the field instead of being diverted for energy use; then it would be helpful if Appendix 4 stated that a letter or attestation from the state land manager would satisfy the requirements. The authors also state (page 134) that to prevent negative impacts on soil nutrients 25% of forest residues should remain on site. This is	L&C Carbon	The commenter raises important points that merit clarification in the appendix. We have significantly expanded the appendix to clarify the process for demonstrating that feedstock procurement does not incur net negative impacts.	<u>Appendix 4:</u> Expanded the categories of criteria that must be monitored and addressed. Provided a suggested format for a Sustainable Feedstock Documentation Plan. Removed references to a requirement to retain 25% of residues in place.

	Comment	Commenter	Response	Changes to Methodology
	arbitrary. Also, it is unclear what residues you are referring to - within the project boundary or within the ownership where the residues are sourced (private property, national forest, state forest, municipality, etc.). Given the economics of forest residue utilization and current value of biomass material, our recommendation would be to drop this requirement entirely.			
A4.7	Page135: forestry feedstock should be harmonized with SB1123 (Calif) Page136 this is not commercially workable. Approved standard practice not 3rd party prof. Orchard removal not harvest.	Gregory Stangl	SB 1123 in California relates to pensions of state employees. The commenter likely mixed up the bill number. Regarding page 136, it is unclear which aspects of the content the commenter finds unworkable. There is no mention of orchard harvest in the appendix.	n/a