Carbon Project Ratings - Biochar Methodology

MSCI ESG Research

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1. Methodology overview

Objective

MSCI Carbon Project Ratings are composite ratings that independently assess the integrity and risks of carbon credit projects across multiple criteria, including their impacts on the climate, environment and society.

A project with a higher rating has a greater likelihood of having a positive emissions impact and a reduced risk of overestimating its emissions impact. It is also more likely that such an emissions impact will have been implemented in a way that supports positive social and/or environmental outcomes and upholds legal and ethical standards. Consequently, a project with a higher rating has a lower likelihood of incurring reputational risks.

Document description

This document describes the detailed project type-specific methodology used to assess Carbon Project Ratings and Pipeline Carbon Project Ratings (but not Preliminary Carbon Project Ratings) for biochar projects.

This project type-specific methodology is applied in addition to, and partially in replacement of, the methodology that is described in the overall MSCI Carbon Project Ratings methodology document, "MSCI Carbon Project Ratings and Assessments Methodology." Where an element of the overall methodology is replaced by this project type-specific methodology, it is detailed below. Every element of the overall MSCI Carbon Project Ratings methodology also applies to MSCI ESG Research's assessment of Carbon Project Ratings and Pipeline Carbon Project Ratings for biochar projects unless explicitly excluded in this document.

Section 2 introduces the core concept of carbon credit integrity and why its assessment is important to the development of the global carbon credit market. Section 3 introduces and defines biochar projects. Sections 4-8 provide details on the project type-specific methodology, including data sources and assumptions, used in MSCI ESG Research's Carbon Project Ratings and Pipeline Carbon Project Ratings assessments for biochar projects.

2. Introduction to carbon project integrity

What is carbon credit integrity?

Carbon credits have varying quality characteristics. These stem from fundamental differences in project types, but also from which methodologies have been used to define each project and create the credits (these methodologies are among the standards set by carbon crediting programs, and are hereafter called crediting program methodologies) and how rigorously they have been applied. Projects also differ in terms of their potential co-benefits and their legal and ethical characteristics.

This variation in quality was not intended. Standard setting and governance bodies attempted to create a system in which all carbon credits had an equivalent climate benefit (representing a tonne of carbon dioxide equivalent [CO_2e] removed or avoided) which could be used for voluntary or compliance purposes. This effort dates back to the Clean Development Mechanism (CDM) created under the 1997 Kyoto Protocol and has continued with the evolution of the carbon credit market.

A key challenge lies in the quantification of the climate benefit of a project — i.e., whether the carbon credits calculated for a project are genuinely equivalent to mitigating or removing one tonne of carbon dioxide from the atmosphere. This difficulty stems from the calculation method used to determine what would have happened in the absence of a project, i.e., in the "baseline" scenario (sometimes referred to as the "counterfactual" scenario).

Another difficulty is that projects differ hugely in age, size and technology. The science behind some crediting program methodologies has also evolved over time, as has the enforcement of standards and levels of governance.

Readers should note that, within the carbon markets, the words "quality" and "integrity" tend to be used interchangeably. Throughout the rest of this document, we use the word integrity when referring to carbon projects.

The importance of assessing carbon credit integrity

Corporate climate action is critical in the fight against climate change, and carbon credits represent an important mechanism for corporates to mitigate their carbon footprint. However, concerns over carbon credit integrity may have held back, and may continue to hold back, the global carbon credit market from reaching its potential. These concerns center around the perception that many carbon credits are of low integrity and are not delivering the benefits they claim to.

In 2021, the Taskforce for Scaling the Voluntary Carbon Market (TS-VCM) found that credit integrity was at the "heart of buyers' hesitancy,"[1] with 45% of buyers identifying it as a key pain point. Buyer concerns around credit integrity and the related risk of being accused of greenwashing due to the use of low-integrity credits have only grown since then. For example, some 55% of respondents to an April 2023 survey run by the Science-Based Targets Initiative (SBTi) stated that the risk of a greenwashing accusation was stopping them from buying more credits.[2]

Concerns over carbon credit integrity have been central to the creation of two major initiatives: the Integrity Council on the Voluntary Carbon Market (IC-VCM) and the Carbon Credit Quality Initiative (CCQI). The IC-VCM aims to create minimum standards of integrity with a set of Core Carbon

[1] "Taskforce on Scaling Voluntary Carbon Markets: Summary of the Public Consultation Report," ICVCM, June 3, 2021.

[2] "Beyond Value Chain Mitigation (BVCM) Research," SBTI_press_release, September 1, 2023.

Principles (CCPs), and the CCQI has developed a comprehensive scoring system for certain project types. Both initiatives primarily assess integrity at the project-type level (primarily based on a project's methodology used) or at the project-registry level (a project registry is an organization that registers mitigation activities and issues carbon credits for the emission reductions or removals achieved by the mitigation activities). Neither initiative assesses integrity at the individual-project level.

MSCI ESG Research's assessment methodology draws on the IC-VCM's and CCQI's approach to assessing integrity, building on their principles to apply a more in-depth evaluation of integrity at the individual-project level.

The key components of carbon project integrity assessment

Market approaches to assessing carbon project integrity typically focus on three main issues:

A. **Emissions impact integrity:** How much CO_2e has been reduced/removed?

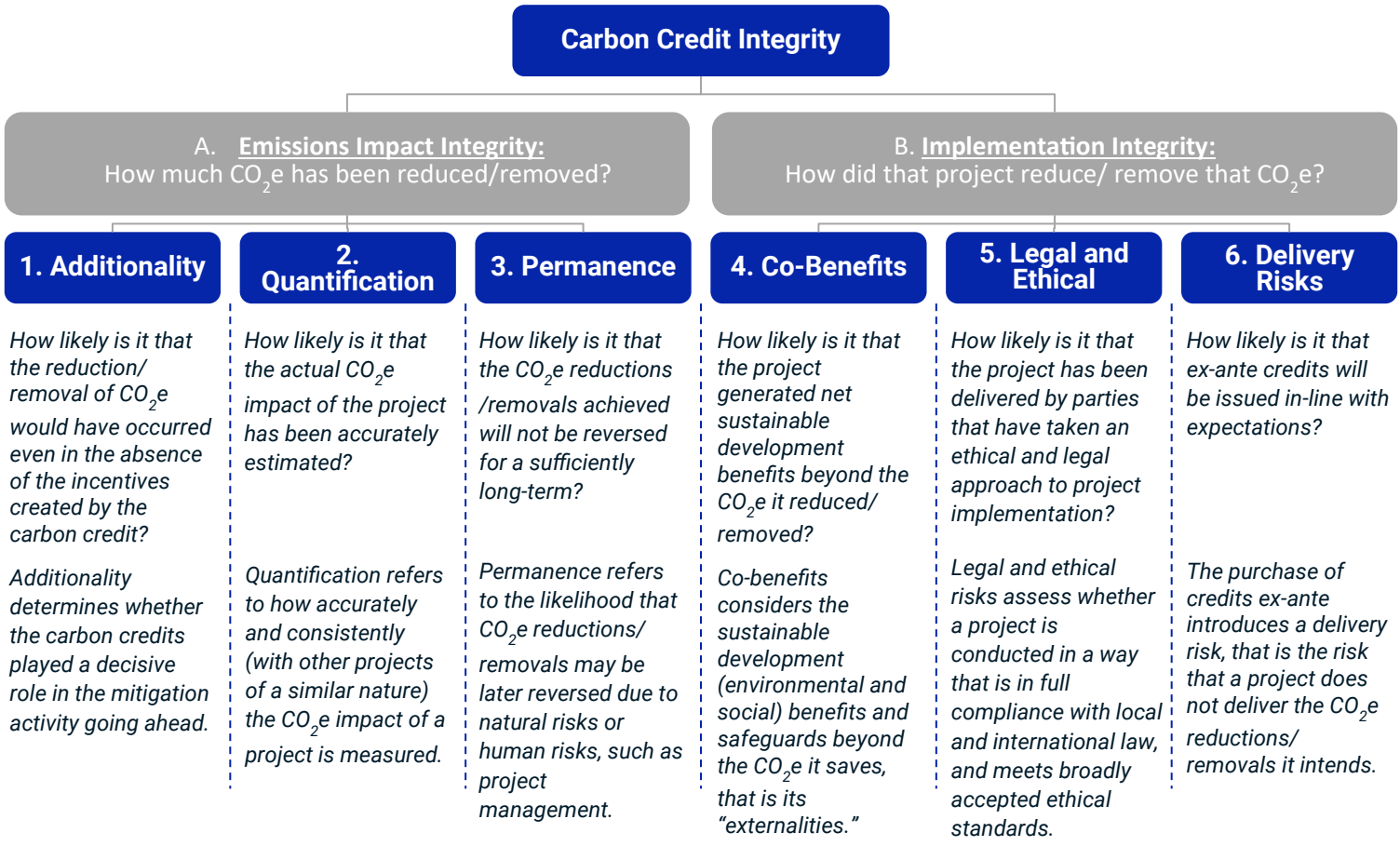
B. **Implementation integrity:** How did that project reduce/remove that CO_2e?

C. **Usage integrity:** How are the credits then reviewed and used?

Emissions impact integrity and implementation integrity can each be further broken down into three main areas of common concern. These are summarized in Figure 1, and outlined in detail below.

Emissions impact integrity, implementation integrity and usage integrity are each described in more detail in the overall MSCI Carbon Project Ratings methodology document "MSCI Carbon Project Ratings and Assessments Methodology."

Figure 1: Key components of carbon project integrity



3. Introduction to biochar projects

What are biochar projects?

To date, the most prevalent means of extracting carbon dioxide from the atmosphere have involved nature-based solutions, such as planting trees and managing soils. While these nature-based assets can be deployed throughout the world, create valuable habitats for wildlife and provide resources for local communities, they suffer from one major drawback — risk of non-permanence. Carbon can be released back into the atmosphere if the vegetation is harvested, burnt or subject to other natural hazards such as pests. For this reason, there has been increased interest in "engineered" forms of carbon dioxide removal (CDR). These are techniques to permanently store carbon in geological or organic form. They include direct air capture, bioenergy with carbon capture and storage (BECCS), biochar and enhanced weathering.

Market Overview

Responding to interest from corporates and a supportive policy environment, innovation and investment in CDR have accelerated between 2021 and 2024.[3] Biochar represents the most prominent type of CDR project currently in the market.

Though growth in biochar has recently increased, the substance itself has existed for centuries as a soil fertilizer. Biochar is the name of the end-product created through a process known as pyrolysis, in which dry organic materials undergo a thermal decomposition in an oxygen-free environment under very high temperatures (of 250-900°C). The dry organic materials usually come from waste biomass, which would otherwise have decayed naturally or been burnt. The charcoal-like end-product called biochar essentially stores and locks away the carbon dioxide.

Though projections during very nascent stages of market development come with high uncertainty, MSCI ESG Research's forecasting modelling indicates demand may grow to 240-380 kilotonnes (kt) of CO2e of carbon-credit retirements by 2030, which represents 10x growth compared to the current number of retirements.4

Key integrity considerations

Biochar is considered by some advocates[5] a "high-integrity" removal technology but there are a number of important considerations that can significantly impact the integrity of a project. Assessing the integrity of biochar projects requires a detailed analysis of both the project's design and assumptions, with risks and opportunities primarily found in five main areas:

- **Financial additionality:** Biochar has a number of valuable end-uses beyond its sale as carbon credits. These alternative revenue streams alone can, in theory, support the profitable development and operation of biochar facilities in the future even without carbon credits. It

[3] Source: MSCI Carbon Markets. Based on tracking of carbon market investments and the number of projects and transactions within different project subtypes.

[4] As of November 2023, there were 36 registered biochar projects globally, primarily registered with the Puro Earth standard. Between August and October 2023, some 25 kt of CO_2 of biochar credits were sold (compared to 50 million issued credits across the Voluntary Carbon Market (VCM) as a whole).

[5] Puro Earth (2022). "High Integrity for Carbon Removals"

is therefore crucial that projects demonstrate that carbon credits were required for the projects to be economically viable.

- **Carbon content quantification:** Biochar usually contains significant amounts of carbon, but the quantification of this is subject to some sampling and measurement risk.
- **Life cycle emissions:** The emissions associated with the biomass inputs and the transportation and processing of these inputs to produce biochar can regularly represent 20% of the total carbon sequestered by the biochar. These life cycle emissions must therefore be appropriately accounted for.
- **Duration:** The carbon storage characteristics of biochar can be highly stable, meaning biochar can act as a near permanent removals technology over a timeframe of up to 100 years. However, over a longer timeframe, there is risk of decomposition, which can vary significantly depending on factors such as the soil temperature and the pyrolysis temperature.
- **Soil health impact:** Biochar that is applied in soils can significantly boost soil health and resilience, and thereby improve the agricultural yield of land and the income of farmers. In this way, Biochar has the potential to deliver significant economic co-benefits to stakeholders.

MSCI ESG Research's assessment of biochar projects entails a detailed assessment of each of these five key risk areas for each individual biochar project.

4. Approach to assessing the integrity of biochar projects

MSCI ESG Research's assessment of biochar projects builds on the overall MSCI Carbon Project Ratings methodology to provide more in-depth analysis of biochar projects. This project type-specific assessment includes sub-criteria that are additional to, and partially in replacement of, the sub-criteria of assessment used in the overall MSCI Carbon Project Ratings methodology, as detailed below. These project type-specific sub-criteria evaluate a deeper set of questions, which are focused on the most important, specific drivers of integrity for biochar projects.

These project type-specific assessments are conducted at the individual project level, including a comprehensive review of each individual project's data and assumptions. In this way, these assessments represent a more granular, project-level review of biochar projects than what would be possible using the overall MSCI Carbon Project Ratings methodology alone.

In total, MSCI ESG Research assesses 12 sub-criteria and 20 topics (see Figure 3) under this project type-specific methodology that are either not assessed or are assessed differently in the overall MSCI Carbon Project Ratings methodology, as illustrated in Figure 2. These sub-criteria are focused on addressing the key drivers of integrity for biochar projects. Each of these sub-criteria align with and replace corresponding sub-criteria scores in the overall MSCI Carbon Project Ratings methodology.

Figure 2: MSCI ESG Research Overall Carbon Project integrity assessment

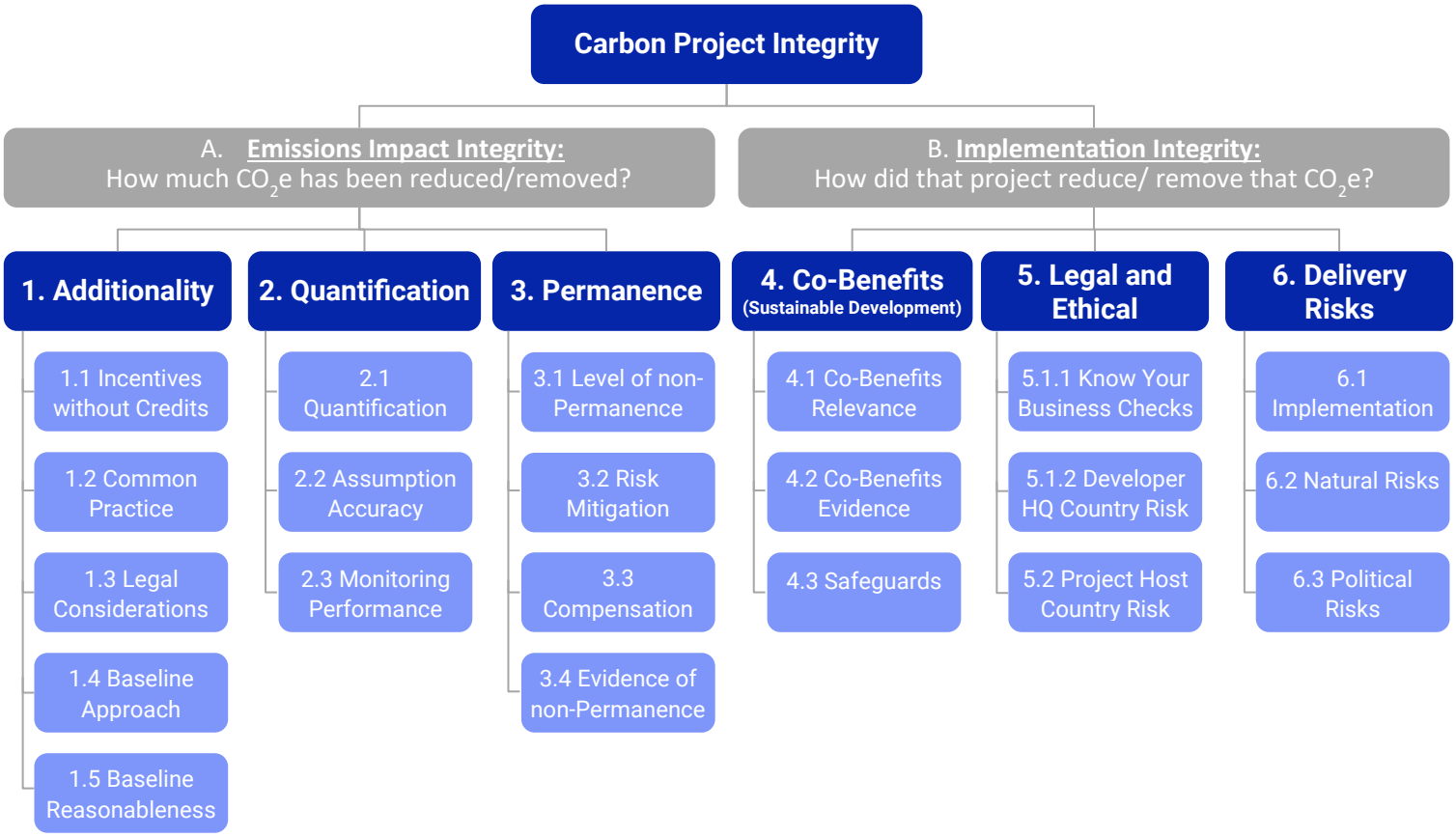
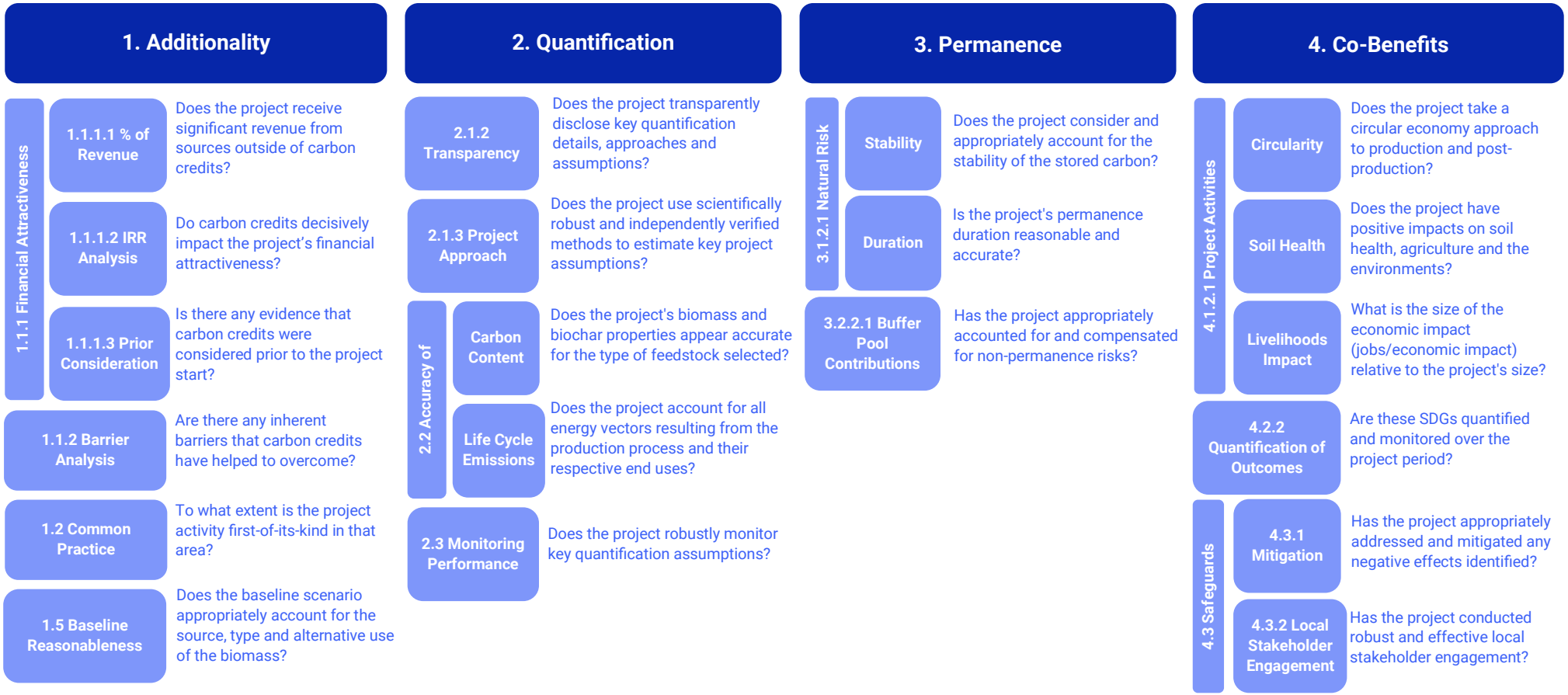


Figure 3: Biochar assessment framework



Assessment of all other criteria and sub-criteria, for example, Criterion 5, Legal and Ethical Risks, and Sub-criterion 3.3, Compensation, within the biochar analysis use the same metrics and methodology as in the overall MSCI Carbon Project Ratings methodology framework. The granularity of the overarching framework for those sub-criteria, and the fact that their assessment is consistent across all project types (i.e., with no biochar-specific characteristics), means that no further enhancement is required.

5. Criterion 1 – Additionality

If a mitigation activity is not additional, then purchasing carbon credits has not led to any additional reduction or removal of emissions. Additionality is therefore a crucial component of the integrity of carbon credits. A non-additional carbon credit has no direct net positive environmental impact given that the emission reductions/removals would have occurred anyway. However, it is worth noting that funding a non-additional credit may still indirectly help stimulate further investment in the same activity by raising its return.

The additionality of a project is not necessarily binary. Projects may be partly additional, where only a portion of emission reductions/removals are additional. For example, if, in the baseline scenario, some emission reductions would have been achieved anyway, but not as much as was achieved by the project, then only this difference in emission reductions is additional. If credits are issued for the total emission reductions rather than only the reductions that wouldn't have otherwise been achieved, then the credits are only partly additional.

There are two main components to assessing additionality: (i) is it likely a project's activities would have occurred without the incentive of a credit, and (ii) how accurately does a project's baseline scenario represent the amount of the CO_2e reduced/removed in the baseline scenario?

MSCI ESG Research's assessment of the additionality of biochar projects focuses on evaluating seven key topics. Figure 4 illustrates the sub-criteria and metrics through which the additionality of biochar projects is assessed, and the overall MSCI Carbon Project Ratings methodology sub-criteria that they refer to. The detailed sub-criteria are described in Figure 5.

Given the probabilistic nature of additionality, MSCI ESG Research scores projects based on the *likelihood* that their emission reductions or removals are additional. To achieve a high Additionality score, a project's activities must be "additional" (Sub-criteria 1.1, 1.2 and 1.3) and its baseline scenario reasonable (Sub-criteria 1.4 and 1.5).

An inverse weighting formula is used to determine a project's overall Additionality score, where the combined scores of Sub-criteria 1.1, 1.2 and 1.3 are inversely weighted with the combined scores of Sub-criteria 1.4 and 1.5. As a result, a high score in any one criterion cannot offset a low score in another.

For example, a biochar project's activities might be very additional given that there may have been few incentives for producing biochar without carbon credits. However, if the biomass would have been used for an application that reduces or removes emissions without the project's activities, then this should be incorporated in any net emission removals calculation.

Figure 4: Biochar additionality assessment approach

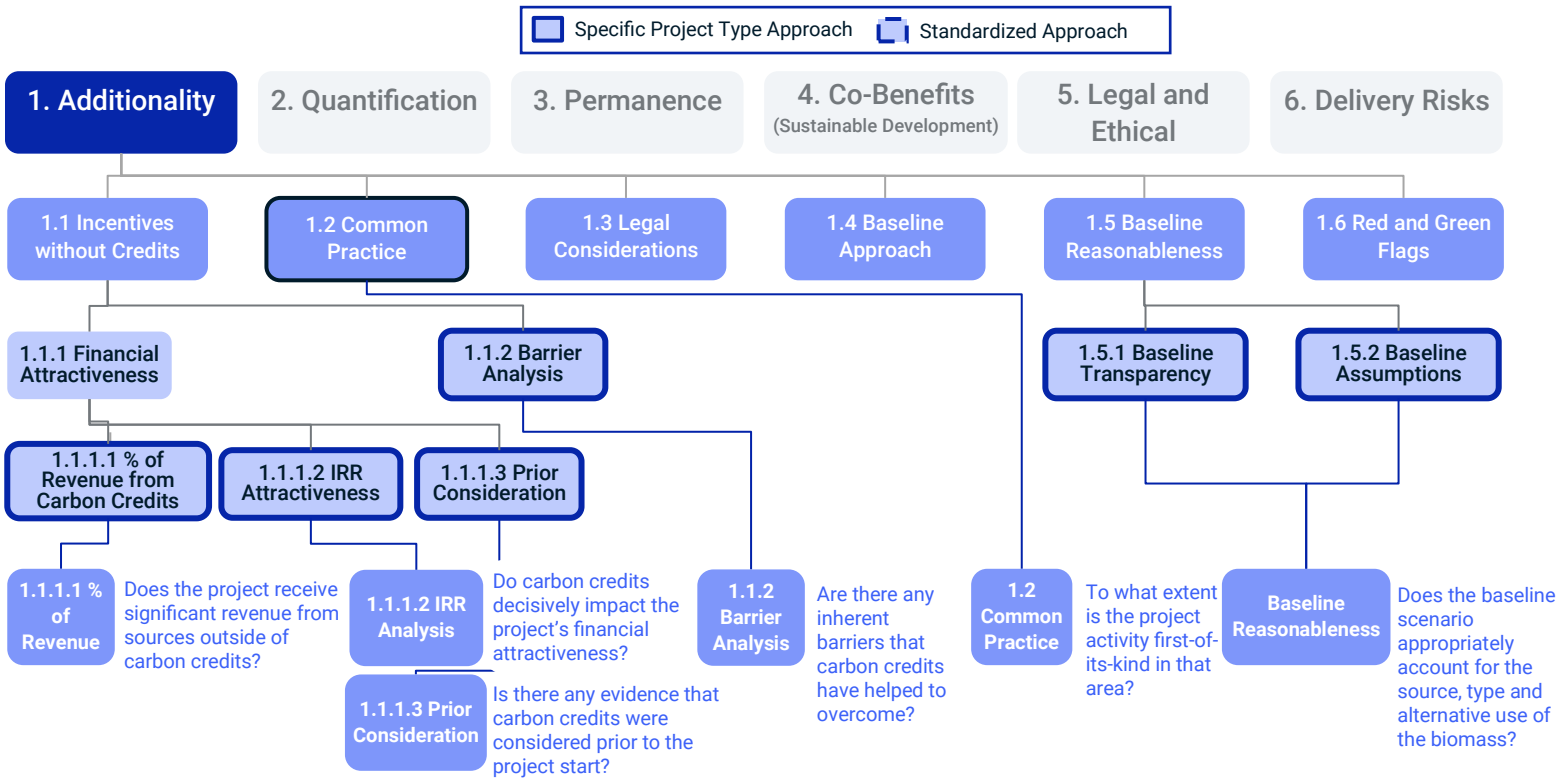


Figure 5: MSCI ESG Research Additionality integrity assessment framework

Sub-criteria		Metrics	Rationale	REDD+	Renewables	ARR	Cookstoves	Biochar	Landfill Gas	Safe Water	IFM	Waste Mgmt.	Blue Carbon
1.1 Incentives without Carbon Credits	1.1.1 Financial Attractiveness	1.1.1.1 % of Revenue from Carbon Credits	The higher the proportion of a project's revenue that comes from carbon credits, the greater the importance of credits to its financial attractiveness.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		1.1.1.2 IRR Analysis	Credits should play a decisive role in making a project financially attractive that would otherwise have not been.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		1.1.1.3 Prior Consideration	Carbon credits should have been clearly considered at the time the decision to go ahead with a project was taken.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	1.1.2 Barrier Analysis	Strength of Barriers	Projects that face high barriers to implementation would be less likely to go ahead without the added incentives of carbon credits.	✗	✓	✗	✓	✓	✗	✓	✗	✓	✓
1.2 Common Practice		Market Penetration	If a practice is already common within a market, it indicates that these types of project will go ahead without the introduction of carbon credits.	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓
1.3 Legal Considerations		Legal Requirements	Projects that are legally required or incentivized are unlikely to be additional. However, if laws are not enforced, then may still be additional.	✗	✗	✗	✗	✗	✓	✗	✓	✓	✓
1.4 Baseline Approach		Baseline Approach	Each project methodology is scored on the extent to which it mitigates the key risks associated with establishing a baseline scenario.	✓	✗	✗	✗	✗	✗	✗	✓	✗	✓
1.5 Baseline Reasonableness		Baseline Transparency	Transparent detail on a project's assumptions is required to make an objective assessment of a project's performance and additionality.	✓	✗	✓	✗	✗	✗	✗	✓	✗	✓
		Baseline Assumptions	MSCI ESG Research assesses the key baseline scenario assumptions for each project type — for example, for REDD+ projects we validate a project's baseline deforestation rates.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1.6 Red and Green Flags		News scanning	Review of academic papers, industry sources and the news for Red or Green Flags to project's additionality.	✓ *Standardized approach*									

✓ *Assessed* ✗ *Not Assessed*

1.1.1.1 % of Revenue from Carbon Credits

There are multiple commercial revenue streams available to biochar producers beyond carbon credits, but primarily three main sources:

1. **Biochar use:** The sale of the biochar to be used as a filler in construction, as a fertilizer, as a feed additive or for soil amendments.
2. **Renewable energy:** The creation of other co-products, such as excess thermal energy during the biochar production, which can be sold as renewable energy.
3. **Waste:** Tipping fees may be received for certain feedstocks by collecting biomass waste that would otherwise have been diverted to landfills.

Given the potential for these alternative revenue streams, it is important that carbon credits are demonstrated to still represent a significant source of revenue for the project, and therefore be influential in the decision to go ahead.

There are two metrics that are used to evaluate this sub-criterion:

- **1.1.1.1.1 Alternative Revenue Sources:** Whether significant alternative revenue sources exist outside of carbon credits given the biochar type and characteristics.
- **1.1.1.1.2 Funding Sources:** Whether the project has received any significant funding sources to support the development and construction of the project.

The overall score for this sub-criterion is reached by weighting 1.1.1.1.1 Alternative Revenue Sources 80% and 1.1.1.1.2 Funding Sources 20% respectively.

1.1.1.1.1 Alternative Revenue Sources

Alternative Revenue Sources refers to the proportion of a project's total revenue that comes from the sale of carbon credits.

Rationale	The higher the proportion of a project's revenue that comes from carbon credits, the greater their likely importance to the financial attractiveness of the project. If credits only represent a fraction of the financial return, but the project can still claim credits representing 100% of the emission reductions or removals achieved, additionality is more uncertain.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑			☑	☑	
Scoring Definition	Each project is scored on a 1-5 scale, where 1 indicates that a very low proportion of revenue comes from carbon credits and 5 indicates that carbon credits are likely the only source of revenue for the project.					
Scoring Approach	MSCI ESG Research conducts a detailed review of project documentation to identify all the sources of revenue of a project. For projects that provide transparent revenue information, this is used to estimate the proportion of the company's expected revenue that will come from carbon credits. Where financial data is not present, the approximate proportion of revenue is estimated for each source given the project's biomass type and country type. For example, the					

relevance of certain revenue streams will be different for a project producing biochar from industrial waste in a high-income country to one producing biochar from manure in an LDC (least-developed country). This is modelled in two steps:

1) **Relevance and Significance of Revenue Sources:** For each biomass type and country type, the relevance and significance of each potential revenue stream to the project is assessed.
    - The revenue sources that are considered are: filler in construction; fertilizer; feed additive; soil amendments; renewable energy; tipping fees and land remediation.
    - The significance of each revenue source includes an assumption, given the current market demand, about what proportion of a project's biochar could be sold through that revenue stream.
    - If projects specifically state a target for a particular revenue source, then this revenue source was assumed to be highly significant.
2) **Approximate Revenue per Tonne of Each Source:** Third-party data on the average revenue potential per tonne for each of these streams is then used to create a bottom-up view of the revenue potential for the project. This is then compared to the expected revenue from carbon credits.

Projects then receive a score from 1 to 5 based on the proportion of revenue that carbon credits are estimated to represent.

1.1.1.1.2 Funding Sources

Funding Sources relate to whether the project has received any significant finance to support development and construction.

Rationale	With the biochar industry in its nascency, there are mechanisms and incentive schemes in place in some countries to support and fund the development of projects. Though these do not represent a long-term sustainable revenue source, they may provide an important initial source of income. Projects that have received significant funding may be more likely to have gone ahead without the security of carbon credit revenue. Given that the demand for biochar outside of carbon credits is expected to grow, high funding levels may allow projects to scale in the near-term and reach a sustainable business model without carbon credits in the medium term.

Key Sources

Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
☑				☑	

Scoring Definition	Each project is scored on a 3-5 scale, where 3 indicates that it has benefitted from a very significant proportion of external funding and 5 indicates that no external funding has been received by the project.
Scoring Approach	MSCI ESG Research conducts a detailed review of the biochar production companies and major grant schemes to identify whether each project had benefitted from any significant external funding sources. These sources include prizes, government grants and private investments.

The score for this sub-criterion is then based on both the type and amount of funding received. Funding sources, such as prizes or local government grants, in which financial returns are not expected from the investment, receive lower scores. Funding sources in which financial returns are expected to the financiers, such as external company investment, receive higher scores given that this funding does not change the potential importance of revenue from carbon credits.

Projects then receive a score based on the type and amount of funding received.

1.1.1.2 Internal Rate of Return (IRR) Analysis

It is important for biochar projects to demonstrate that the presence and opportunity of carbon credits played the decisive role in making them financially attractive. Projects can evidence this by transparently disclosing key financial assumptions, and their profitability both with and without carbon credits. Ideally, carbon credit revenue will materially impact the profitability of the project, making a project that would otherwise have been financially unattractive into a highly attractive one.

There are three metrics that are used to evaluate this sub-criterion:

- **1.1.1.2.1 Financial Tests and Transparency:** Whether the project uses a detailed and transparent approach to their financial analysis.
- **1.1.1.2.2 Strength of Financial Analysis:** Whether carbon credits appear to play a decisive role in the project being financially attractive.
- **1.1.1.2.3 Accuracy of Assumptions:** Whether the project's key financial assumptions appear accurate and appropriate against benchmarks.

The overall score for this sub-criterion is reached by weighting 1.1.1.2.2 Strength of Financial Analysis 50% and the other two factors 25% each.

1.1.1.2.1 Financial Tests and Transparency

Financial tests refer to whether the project uses a detailed and transparent approach to financial analysis.

Rationale	A project that conducts a more extensive financial analysis, in which key information is transparently given, provides more support and credibility to the outcome of that analysis.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑					
Scoring Definition	Each project is scored on a 1-5 scale, where 1 indicates that it has not conducted any financial analysis and 5 indicates that the project conducted a full IRR or Net Present Value (NPV) analysis and included detailed cost assumptions.					
Scoring Approach	Through a detailed review of a project's key documents, MSCI ESG Research reviews the approach that a project took regarding its financial analysis and the types of tests performed.					

Projects are then evaluated based on both the project's approach and the transparency of information provided.

1.1.1.2.2 Strength of Financial Analysis

Strength of Financial Analysis relates to whether carbon credits appear to play a decisive role in the project being financially attractive.

Rationale	Carbon credits should incentivize actors to implement mitigation activities that would not otherwise have been financially attractive without those revenues. Ideally, carbon credits will make a mitigation activity that would otherwise have been financially unattractive into a financially viable one. Assessing a project's internal rate of return is therefore an important indicator of the likelihood of additionality.

Key Sources

Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
☑			☑	☑	

Scoring Definition	Each project is scored on a 1-5 scale where 1 indicates low likelihood that carbon credits decisively changed the IRR attractiveness, and 5 indicates very high likelihood that carbon credits decisively changed the IRR attractiveness of the project.

Scoring Approach

MSCI ESG Research conducts a detailed review of project documentation to identify the revenue, cost and profitability metrics of a project. For projects that provide transparent IRR information, this is used to estimate the pre-credit and post-credit IRR of the project.

Where financial data is not present, a bottom-up simple IRR model is used for the project based on the expected revenues and costs of the project given its characteristics (biomass type, country type, technology type and scale). This is modelled in three steps:

1) **Approximate Cost Benchmarking:** For each biomass type, country type, technology type and scale of project, benchmark Capex, Opex and Feedstock costs figures are sourced from a wide range of sources. For each project, the per tonne of CO_2e cost figure for the project given its core characteristics is then estimated.
2) **Approximate Revenue per Ton of Each Source:** As described in sub-criterion 1.1.1.1.1 Alternative Revenue Sources, third-party data on the average revenue potential per ton for each of these revenue streams is used to create a bottom-up view of the revenue potential for the project.
3) **Pre- and post-credit IRR:** Based on these inputs, an expected IRR for the project over a 25-year timeframe is calculated.

The overall IRR score for each project is then determined based on the scores for each relevant indicator. A high score is needed on each indicator to achieve a high overall score.

Three components of IRR analysis:

Financial attractiveness without carbon credits *(Pre-credit IRR)*

Projects that are not financially attractive without carbon credits are unlikely to have gone ahead without them. A project's internal rate of return without carbon credits is compared to a benchmark rate of return relevant to that project type and country. If the pre-credit IRR is significantly lower than the required benchmark, then this indicates that the project would likely not otherwise have taken place.

Financial attractiveness with carbon credits *(Post-credit IRR).*

Carbon credits should make mitigation activities that would have been unattractive into financially viable projects. Comparing a project's post-credit IRR (IRR with carbon credit revenues) to the required benchmark indicates whether a project is financially viable with carbon credits. The likelihood that the activity is additional is high if the post-credit IRR clearly exceeds the benchmark.

Change in financial attractiveness due to carbon credits *(Absolute Difference between Post-Credit and Pre-Credit IRR).*

If the proceeds from carbon credits materially change the financial attractiveness of an activity, it is more likely that the carbon credits have played a decisive role. Alternatively, if carbon credits only mildly impact the financial attractiveness of a project, then higher uncertainty exists.

1.1.1.2.3 Accuracy of Assumptions

Accuracy of Assumptions relates to whether the project's key financial assumptions appear appropriate and reasonable given the project's characteristics.

Rationale	Projects that use inappropriate or unreasonable assumptions within their financial additional analysis may over-state their financial additionality.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑				☑	

Scoring Definition	Each project is scored on a 1-5 scale, where 1 indicates that there is a very high risk that project's key assumptions are significantly over-estimated compared to benchmark values, and 5 indicates that there is a very low risk that project's key assumptions are inaccurate.
Scoring Approach	MSCI ESG Research extracts the values for key financial assumptions from project documentation and compare these assumptions against third-party country-specific benchmarks. The reasonableness of each of these key assumptions is scored on a 1 to 5 scale based on a comparison of a project's assumption against benchmark values.

1.1.1.3 Prior Consideration

Projects that can demonstrate that carbon credits were considered prior to their decision to start, provide more evidence that credits acted as an important incentive in starting mitigation activities.

Two key sub-criteria are used to evaluate this:

- **1.1.1.3.1 Evidence of Consideration:** Whether any evidence exists that credits were considered prior to the project start.
- **1.1.1.3.2 Registration Gap:** Whether a significant gap exists between the start of the project's activities and the initial registration and issuance date.

The overall score for 1.1.1.3 Prior Consideration is determined by an equal weighting of these sub-criteria.

1.1.1.3.1 Evidence of Consideration

Evidence of consideration refers to whether the project has specific evidence that demonstrates that the use of carbon credits was considered prior to the project start date.

Rationale	Evidence that carbon credits were considered prior to the project start date indicates that credits played an important role in this decision process. On the other hand, if no evidence of prior consideration exists, there is a higher chance that the decision to go ahead with the project occurred without any expectation of carbon credits.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑					
Scoring Definition	Each project is scored on a 1-5 scale, where 1 indicates that no evidence has been made available, and 5 indicates that good quality evidence of prior consideration exists.					
Scoring Approach	MSCI ESG Research identifies whether any evidence exists that carbon credits were considered prior to the project start date. This evidence may include projects signing up to Puro Earth's pre-registration scheme, in which case they are clearly considering carbon credits from the outset of the project. The date of any evidence of carbon credit consideration is then compared to the project start date to determine whether credits were considered prior to the start date or not.					

1.1.1.3.2 Registration Gap

Registration gap evaluates the gap between the start date of the project activity and the project being registered with a crediting standard and able to issue credits.

Rationale	A longer gap between the start of project activity and the project's registration suggests the project was able to maintain, at least to an extent, activities, and investment even in the absence of carbon credits. If credits were very important and decisive in the project going ahead, then we would typically expect a project to work hard to minimize this time taken in the registration process.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets

	☑					☑

Scoring Definition	Each project is scored on a 1-5 scale, where 1 indicates a very significant gap between the initial decision date and the registration date and 5 indicates a short or inconsequential gap.
Scoring Approach	MSCI ESG Research analyzes project documentation to determine the project's start date and compared this to the date of registration and date of first issuance of the project using the MSCI Carbon Markets platform. The project stated start date is compared to the registration/issuance date and then categorized the gap between these dates into a 1 to 5 scale.

1.1.2 Barrier Analysis

Barrier Analysis refers to whether any barriers exist that would have prevented the project moving forward without carbon credits.

Rationale	Barriers may exist to the development of a project that carbon credits can help to overcome through providing an additional incentive to the projects. These barriers may be technological, in terms of the lack of capabilities and resources required to execute the project, or financial or cultural.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑				☑	☑

Scoring Definition	Each project is scored on a 1-5 scale, where 1 indicates that there are no significant barriers to entry inherent to the project and 5 indicates that there are several barriers to entry which are highly likely to have prevented the project going ahead.
Scoring Approach	Both the stated and inherent barriers that exist to a project are analyzed. For the stated barriers, a detailed review of project documentation is conducted to understand whether any barriers had been explicitly mentioned and evidenced. Assumptions are made regarding two key characteristics of the project to determine whether inherent barriers existed that would have otherwise prevented the project from going ahead. The two characteristics are: - **Country Type:** The level of economic development of the county in which the project takes place. - **Developer Type:** The type of company that developed the project, and whether they have the technical and financial capabilities to have carried out the project anyway. Each project is then scored on a 1 to 5 scale based on these two inputs and the stated barriers used.

1.2 Common Practice

If biochar production is already common practice within a region at the time a project started, then it suggests that the project's activities could have been implemented without carbon credits.

There are two metrics that are used to evaluate this sub-criterion:

- **1.2.1 First-of-its-kind:** The extent to which the project is first-of-its-kind in that region or country.
- **1.2.2 Country Incentives:** Whether any country-level incentive schemes exist that are heavily promoting the development of similar projects in that region.

Each of these criteria is assessed independently on a scale of 1 to 5.

The overall score is then based on weighting 1.2.1 First-of-its-kind 80% and 1.2.2 Country Incentives 20%.

1.2.1 First-of-its-kind

First-of-its-kind relates to whether the project is first-of-its-kind in that region or country.

Rationale	If a project represents the first project of that technology type to be developed in that country, then the technology is clearly not common practice, and the project will be tackling unique development challenges within that country. In contrast, projects that are developed in a region in which numerous biochar facilities already exist, then it suggests that the project's activities could have been implemented even without carbon credits given the nascency of the carbon markets for biochar.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑				☑	
Scoring Definition	Each project is scored on a 1-5 scale, where 1 indicates that over 100 biochar facilities already exist in the country, and 5 indicates the project is first-of-its-kind in that region.					
Scoring Approach	MSCI ESG Research reviews project documentation to assess how many similar projects were identified. This is the combined with a third-party review of the number of biochar facilities that exist in the country to determine how common practice this technology is. Projects are then scored on a scale of 1 to 5, based on the number of similar projects.					

1.2.2 Country Incentives

Country Incentives assesses whether any country-level incentive schemes exist that are heavily promoting the development of similar projects in that region.

Rationale	Though a technology may not be common practice already in that region, government incentive schemes may be in place to rapidly incentivize the adoption and development of this technology. This represents a high indication that the technology will become common practice in the future.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑				☑	
Scoring Definition	Each project is scored on a 1-5 scale, where 1 indicates significant government funding schemes exist that heavily subsidize biochar production, and 5 indicates that no government funding schemes exist.					
Scoring Approach	MSCI ESG Research conducts a detailed review of the country's government policies relating to biochar to determine the presence and significance of any government programs that incentivize biochar production. To account for differences in country size, this figure is adjusted based on the amount of funding per current operational biochar facility. Each project is scored based on the relative amount of government support per current project.					

1.5 Baseline Reasonableness

Biochar is produced from a biomass input. Without the project going ahead, different types of biomass may have been used for alternative uses. It is important that biochar projects appropriately consider the alternative use for the biomass type, and the emissions impact that this alternative use would have created.

Biochar projects should appropriately assess the potential uses of the biomass in the baseline scenario (the counter-factual scenario without the project's activities), and account for any emissions impact that would have occurred without the project.

As it is not possible to know for certain what would have happened in this counterfactual scenario, assessing the reasonableness of a project's baseline scenario assumptions must be done in a probabilistic way.

Two sub-components are considered to evaluate a project's baseline reasonableness:

- **1.5.1 Relevance of Baseline Scenario:** Whether the project's baseline scenario appears reasonable given the biomass type.
- **1.5.2 Biomass Sourcing:** Whether the project provides evidence that that the biomass was sourced in a sustainable way.

Each of these criteria is assessed independently on a scale of 1 to 5. The overall score is reached through an equal weighting of both sub-criteria.

1.5.1 Relevance of Baseline Scenario

Relevance of Baseline Scenario relates to whether the project's baseline scenario appears reasonable given the biomass type.

Rationale	To accurately estimate the net emissions impact, projects must appropriately account for what would have happened to the biomass without the project scenario. Projects

	that do not appropriately account for any emission reduction or removals that would have occurred otherwise will over-estimate their total impact.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑				☑	

Scoring Definition	Each project is scored on a 3-5 scale, where 3 indicates that the project's baseline scenario is assessed as implausible and is likely to under-estimate the emissions impact in the baseline scenario and 5 indicates that the project uses an appropriate baseline scenario or a baseline scenario that minimizes risk of baseline over-estimation.
Scoring Approach	The relevance of the baseline scenario is assessed by comparing the project's stated baseline scenario with an independent evaluation of the most relevant baseline given the biomass type and region type. Each of these inputs is determined as follows: - **Stated Baseline Scenario:** A detailed evaluation of project documentation is assessed to understand what the project assumes would have happened to the biomass without the project. - **Most Relevant Baseline Scenario:** Through a comprehensive review of academic and third-party literature, for each biomass type and region type, MSCI ESG Research evaluate what the most relevant baseline scenario would have been for each biomass and region type. For example, in Finland, the most relevant baseline scenario for wood residues may be Energy Use, while in Sub-Saharan Africa where less mature energy markets exist, the biomass may be left to decay. Projects are then scored on a 1 to 5 scale based on how relevant and likely the project's baseline scenario is.

1.5.1.2 Biomass Sourcing

Biomass Sourcing refers to whether the project provides evidence that the biomass was sourced in a sustainable way.

Rationale	Projects that took place on recently forested land are more likely to experience natural forest regrowth and regeneration. In contrast, if the project area has remained barren throughout its recent history, the likelihood of natural regrowth is lower.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑	☑				

Scoring Definition	Each project is scored on a 1-5 scale, where 1 indicates that there has been very high forest cover in the project area over the past 10 years and recent history of harvesting, and 5 indicates that there is no recent history of forest cover or forest loss.

Scoring Approach	MSCI ESG Research conducts a detailed review of the project's documentation and company information to determine whether the project has any evidence or certification related to the sustainable sourcing of the biomass. Each project is then scored from 1-5 based on whether any evidence is provided that the biomass is sustainably sourced.

6. Criterion 2 – Quantification

Quantification refers to the likelihood that the emission reduction or removals claimed by a project are accurate, assuming the baseline scenario is correct. It includes both emission reductions or removals within a project area, and those that have occurred outside the project area, known as leakage.

Along with the strength of baseline assessment, Quantification is a key determinant of the risks of over-crediting: whether the number of credits issued by the project is equal to the CO_2e actually reduced/removed. In theory, all carbon credits are worth the equivalent of 1 tonne of CO_2e reduced or removed. A low carbon quantification score means that the emission reductions or removals delivered by the credit is likely to be less than 1 tonne. In this case, buyers should be cautious in using one credit to offset 1 tonne of their own CO_2e emissions as they are unlikely to be equivalent.

Quantifying a biochar project's emission removals requires both an estimate of the carbon sequestered within the end product, and an evaluation of the total emissions impact throughout the life cycle of the production process. The total quantification must take into account relevant emissions associated with the biomass type across its lifetime from "cradle-to-grave" to ensure the emissions impact represents the true net emissions impact of the project.

Figure 6 illustrates the sub-criteria through which MSCI ESG Research assesses the quantification of biochar projects, and the Integrity Assessment framework sub-criteria that they refer to. The detailed sub-criteria are described in Figure 7.

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Figure 6: Biochar Quantification assessment approach

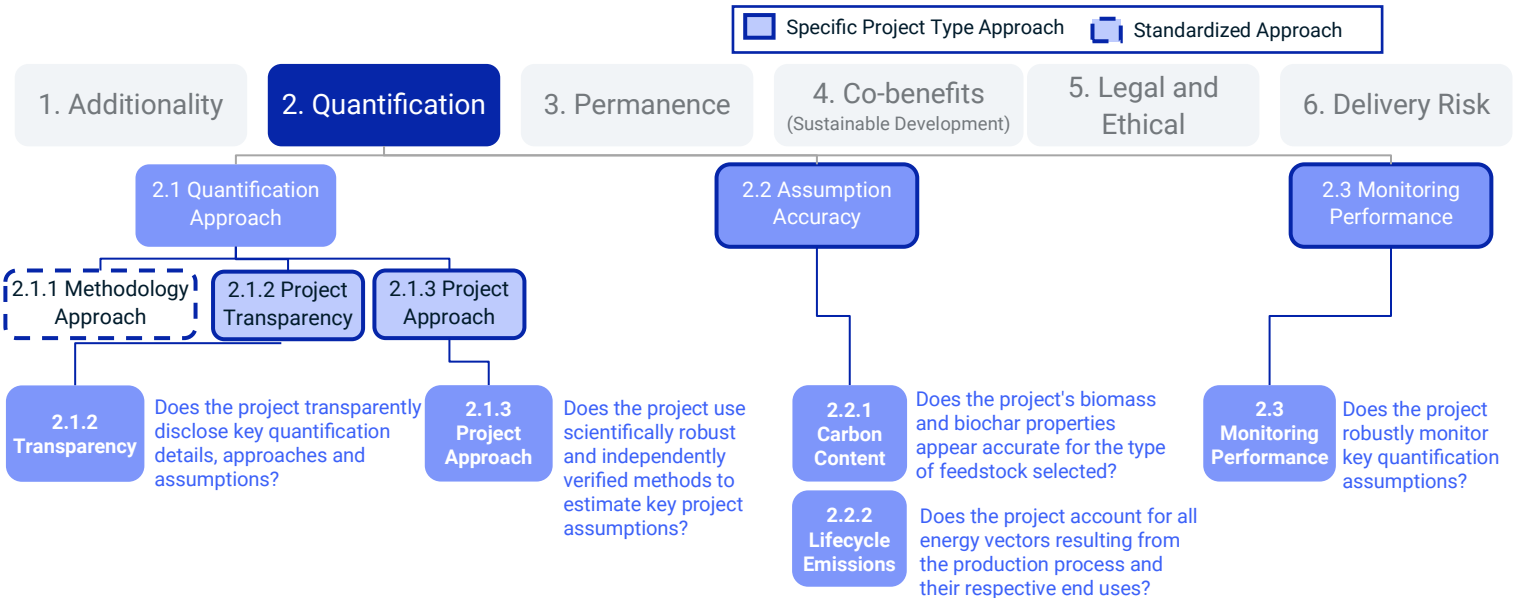


Figure 7: MSCI ESG Research Quantification integrity assessment framework

Sub-criteria	Metrics	Rationale	REDD+	Renewables	ARR	Cookstoves	Biochar	Landfill Gas	Safe Water	IFM	Waste Mgmt.	Blue Carbon
2.1 Quantification Approach	2.1.1 Methodology Approach	Through setting the assumptions that projects must make, and the sources that can be used to estimate them, crediting program methodologies can play an important role in reducing or even increasing the level of quantification risk.	✓ *Standardized approach*									
	2.1.2 Project Transparency	Transparent documentation and detail on a project's assumptions are required to make an objective assessment of its approach to carbon quantification.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2.1.3 Project Approach	Two projects with the same methodology may carry different quantification risks depending on the approaches that each use.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.2 Assumption Accuracy	Quantification Accuracy	Each project type has a set of key assumptions that determine the accuracy of their carbon quantification. Evaluating the reliability and accuracy of these key assumptions shows whether a project has over- or understated their emission reductions or removals.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.3 Monitoring Performance	2.3.1 Monitoring Plan	Projects that have effective processes in place to regularly monitor and measure key quantification inputs and assumptions are more likely to accurately estimate and update their emissions impact.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2.3.2 VVB Analysis	Projects that use a diverse mix of well-regarded verification and validation bodies (VVBs) will improve the likelihood that key quantification details are accurately checked and validated.	✓ *Standardized approach*									
2.4 Red and Green Flags	News scanning	Review of academic papers, industry sources and the news for Red or Green Flags relating to project's quantification.	✓ *Standardized approach*									

2.1.2 Transparency

Transparency refers to whether the project transparently discloses key quantification details, approaches, and assumptions.

Rationale	Projects that do not disclose key information regarding their quantification approaches and assumptions create greater uncertainty. Lack of transparency fundamentally limits the ability to determine whether the project has used appropriate and best-practice approaches and assumptions.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑				☑	
Scoring Definition	Each project is scored on a 5-point scale from 1 to 5, where 1 indicates a relatively low transparency and 5 indicates that all key details and assumptions have been transparently disclosed.					
Scoring Approach	MSCI ESG Research conducts a detailed review of project documentation to identify all relevant quantification details and assumptions provided. Biochar project developers are also contacted in order to provide another opportunity to submit any missing information. There were six key factors that are identified: a) volume of biomass used; b) type of biomass; c) biomass carbon content; d) volume of biochar generated; e) biochar carbon content; f) hydrogen to carbon ratio. Projects are then scored on a 1 to 5 scale based on how many of these 6 factors are transparently disclosed.					

2.1.3 Project Approach

Projects that use scientifically best-practice techniques to estimate key components of their quantification increase the probability that CO_2e impact will be accurately measured.

There are two metrics that are used to evaluate this sub-criterion:

- **2.1.3.1 Quantification Methods:** Whether the project uses scientific best-practice approaches to estimating key project quantification assumptions.
- **2.1.3.2 Testing and Sampling Methods:** Whether the project uses representative testing and sampling techniques to verify key project assumptions.

The overall score for this sub-criterion is reached by weighting each of these factors by 50%.

2.1.3.1 Quantification Methods

Quantification Methods relates to whether the project uses scientific best-practice approaches to estimating key project quantification assumptions.

Rationale	Given the nascency of the biochar industry, the science behind the best approaches to estimate the amount of carbon sequestration is still developing. It is important that projects keep pace with scientific developments, and ensure they use well-founded techniques to measure their emissions impact.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑		☑		☑	
Scoring Definition	Each project is scored on a 5-point scale from 1 to 5, where 1 indicates that none of the key six inputs are used within quantification and 5 indicates that the project uses a					

	combination of organic and fixed carbon content, and hydrogen to carbon (H:C) and oxygen to carbon (O:C) ratios.
Scoring Approach	Quantification Methods are assessed based on both an individual project's stated approach and the relevant methodological requirements for biochar quantification. The use of six key inputs within the quantification method are analyzed: organic carbon content, fixed carbon content, H:C ratio, O:C ratio, material half-life and mineralization. The methodological requirements for biochar quantification are then considered to determine which of these six key inputs is required as part of the quantification approach. Given some methodologies require certain approaches to be used, this methodology review can provide an indication of the project's approach even when not transparently disclosed. Projects are then scored on a 1 to 5 scale based on the types of methods used or required, with projects using organic and fixed carbon content, H:C molar ratio and O:C ratio achieving the highest score. The methodological requirements therefore represent a minimum score that projects can achieve, though individual projects that go beyond the base methodological requirements can receive a higher score.

2.1.3.2 Testing and Sampling Methods

Testing and Sampling Methods refer to whether the project uses representative testing and sampling techniques to verify key project assumptions.

Rationale	A crucial process in a biochar project's quantification is to measure the amount of carbon stored within the biochar end-product through an analysis of a sample of produced biochar. It is crucial that this measurement is conducted in a representative way to ensure that the carbon content is accurately measured.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑		☑		☑	
Scoring Definition	Each project is scored on a 5-point scale from 1 to 5, where 1 indicates that no laboratory testing is used, and 5 indicates that the project transparently uses an independent laboratory test on a representative sample of biochar.					
Scoring Approach	MSCI ESG Research conducts a detailed review of both project and methodology documentation to understand the procedures used to measure the carbon content within biochar. In combination, this provides a view of both what projects are required to do as part of their estimates, and whether individual project's approach went above or below this requirement. Projects are then scored on a 1 to 5 scale based on the type of methods conducted, and whether the project provided additional information and depth beyond the methodological requirements.					

The methodological requirements represent a minimum score that projects can achieve, but projects that go beyond the base methodological requirements can receive a higher score.

2.2 Accuracy of Assumptions

The accuracy of key project quantification assumptions is evaluated against a combination of MSCI EST Research and third-party estimates to determine whether they appear reasonable.

There are two components that are used to evaluate this sub-criterion:

- **2.2.1 Carbon Content:** Whether the project's carbon content assumptions for both biochar and feedstock appear appropriate given the biomass and feedstock mix.
- **2.2.2 Life Cycle Emissions:** Whether the project appropriately accounts for all energy vectors resulting from the biochar production process.

Each of these criteria are evaluated on a 1 to 5 scale. 2.2.1 Carbon Content is weighted 75% and 2.2.2 Life Cycle Emissions is weighted 25%.

2.2.1 Carbon Content

Carbon Content relates to whether the project's carbon content and assumptions for both biochar and feedstock appear appropriate given the biomass and feedstock mix.

Rationale	Estimation of the carbon content within the input biomass and end product is crucial in measuring the amount of carbon sequestered as part of the biochar production process. Measuring the carbon content is subject to some uncertainty, and projects that over-estimate the carbon content will therefore over-estimate their emission removal impact.

Key Sources

Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
☑				☑	

Scoring Definition	Each project is scored on a 1 to 5 scale, where 5 indicates the project's carbon content assumptions appear in-line with third-party data, 3 indicates that the project's estimates are 50% higher than third-party estimates and 1 indicates that the project's estimate is over 100% higher than third-party estimates.
Scoring Approach	MSCI ESG Research extracts information on a project's assumptions on the carbon content within the biochar and feedstock. Third-party data from Phyllis2 is then used to identify the range of carbon content found for the applicable biochar or biomass type.[6] The project's estimate is then compared to the maximum value from the relevant third-party estimate identified. For example, for biochar projects in which the feedstock is coffee husk, third-party data on

[6] Phyllis2. *"ECN Phyllis classification"*. Accessed November 30, 2023. https://phyllis.nl/Browse/Standard/ECN-Phyllis

the carbon content for coffee husks is used. For this feedstock type, the range identified was 45-60% and so the maximum 60% figure is used.

Projects are then scored on a 1 to 5 scale for both the biochar and feedstock assumptions based on the difference between the project and third-party estimate.

2.2.2 Life Cycle Emissions

The biochar production process involves a complex number of stages, from the initial growth and sourcing of the biomass to the processing and transportation of it, and the final production processes. Through this life cycle, the process may involve emissions at each stage which must be taken into account of in order to reach an accurate estimate of the overall net emissions impact from the project. Projects must consider all stages and energy vectors throughout this process.

There are three main components that are used to evaluate this sub-criterion:

- **2.2.2.1 Pre-processing Life Cycle Stages:** Whether the project appropriately accounts for project emissions across all stages of the biomass pre-processing life cycle.
- **2.2.2.2 Processing Energy Vectors:** Whether the project appropriately accounts for all energy vectors during the processing stage.
- **2.2.2.3 Post-processing:** Whether the project appropriately accounts for all post-processing project emissions using best-practice approaches.

The overall score is reached through an equal weighting of these three factors.

2.2.2.1 Pre-Processing Life Cycle Stages

Pre-processing Life Cycle Stages relates to whether the project appropriately accounts for project emissions across all stages of the biomass life cycle.

Rationale	Prior to the pyrolysis stage, projects must appropriately account for all the project emissions associated with the growth and supply of biomass to the processing facilities.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑		☑			
Scoring Definition	Each project is scored on a scale of 1 to 5, where 1 indicates that no pre-processing life cycle stage emissions are accounted for and 5 indicates that all pre-processing project emissions are appropriately accounted for and provided within a full life cycle assessment.					
Scoring Approach	MSCI ESG Research conducts a detailed review of both project and methodology documentation to understand which stages of the biomass life cycle had been accounted for. In combination, this provides a view of both what projects are required to do as part of their estimates, and whether individual project's approach go above or below this requirement in their depth and transparency of information. Projects are assessed based on whether they provided a complete life cycle assessment, and alternatively which of six key factors that are assessed for whether					

they are accounted for as part of their life cycle analysis: i) the quantity of biomass sourced and used; ii) accounting of transport; iii) accounting of storage; iv) accounting of production (including cultivation and harvesting); v) accounting of total use emissions; vi) whether removals were stated.

Projects that provide a complete life cycle assessment score a 5. Otherwise, projects are then scored on a 1 to 5 scale based on how many of the six factors are disclosed or required by the methodology.

2.2.2.2 Processing Energy Vectors

Processing Energy Vectors relates to whether the project appropriately accounts for all energy vectors resulting from the production process and their respective end-uses.

Rationale	The pyrolysis production process can be heavily energy-intensive given the temperatures required. It is important that projects appropriately account for any emissions used during this process to ensure they are accurately estimating their net emissions impact.

Key Sources

Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
☑		☑			

Scoring Definition	Each project is scored on a scale of 1 to 5, where 1 indicates no processing energy vectors are accounted for and 5 indicates that all relevant energy vectors are accounted for.
Scoring Approach	MSCI ESG Research conducts a detailed review of both project and methodology documentation to understand which energy vectors had been accounted for during the production process. In combination, this provides a view of both what projects were required to do as part of their estimates, and whether an individual project's approach went above or below this requirement in its depth and transparency of information. Projects are assessed based on whether they provided a complete assessment of all energy vectors, and alternatively which of six key factors are accounted for as part of their life cycle analysis: i) syngas; ii) wood vinegar; iii) renewable energy; iv) heat recovery; v) accounting for energy self-consumption; vi) vent accounting. Projects that provide a complete energy vector assessment score a 5. Otherwise, projects are then scored on a 1 to 5 scale based on how many of the 6 factors are disclosed or required by the methodology.

2.2.2.3 Post-processing Emissions

Post-processing Emissions refers to whether the project appropriately accounts for all such emissions using best-practice approaches.

Rationale	Once biochar has been produced, it then needs to be handled, transported and stored in an end-application. This post-production process can generate emissions that must

	be appropriately accounted for in order to ensure that a project's net emission calculations are accurate.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑		☑			

Scoring Definition	Each project is scored on a scale of 1 to 5, where 1 indicates no post-processing emissions are accounted for and 5 indicates that all post-processing stages are appropriately accounted for.
Scoring Approach	MSCI ESG Research conducts a detailed review of both project and methodology documentation to understand which post-production stages had been accounted for. In combination, this provides a view of both what projects were required to do as part of their estimates, and whether individual project's approach go above or below this requirement in its depth and transparency of information. Projects are assessed based on whether they provided a complete assessment of all post-production stages, and alternatively which of three key factors are accounted for as part of their life cycle analysis: i) transportation; ii) handling; iii) other post-processing emissions. Projects that provide a complete post-production assessment score a 5. Otherwise, projects are then scored on a 1 to 5 scale based on how many of the 3 factors are disclosed or required by the methodology.

2.3 Monitoring Performance

Monitoring relates to whether the project frequently monitors carbon stock and if the techniques used are appropriate and will provide accurate measurements.

Rationale	Regular monitoring, sampling and auditing can reduce quantification risks due to sampling error.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑				☑	

Scoring Definition	Projects are scored on a 1 to 5 scale, where 1 indicates that no audits or samples have been conducted, and 5 indicates that audits, sampling and site visits are conducted at least annually.
Scoring Approach	MSCI ESG Research conducts a detailed review of project documentation in order to assess the auditing and site visit procedures for the project. For each project, the frequency of three main monitoring factors are assessed: - **Audit Frequency:** The number of audits conducted each year since the project started. - **Sampling:** The frequency of biochar sampling.

- **Site Visits:** The frequency of site visits.

For each of these monitoring factors, projects are scored on a 1 to 5 scale, where 5 indicated that the frequency is at least annual, and 1 indicates that the factor has not been monitored since the project start. The overall score is then based on an average of these three scores.

7. Criterion 3 - Permanence

Permanence refers to the likelihood that the emission reductions or removals achieved by a project will be sufficiently long-term and not released back into the atmosphere. There is growing consensus that 100 years represents a good benchmark for projects to be classified as "permanent." The IC-VCM's Core Carbon Principles require a monitoring and compensation period of at least 40 years for nature-based projects.

A permanent reduction or removal can only be guaranteed where it is physically impossible for a reversal to occur. However, for most projects, a risk of reversal does, to some extent, exist. This risk may be due to natural risks, such as wildfires, or human risks, such as poor project management.

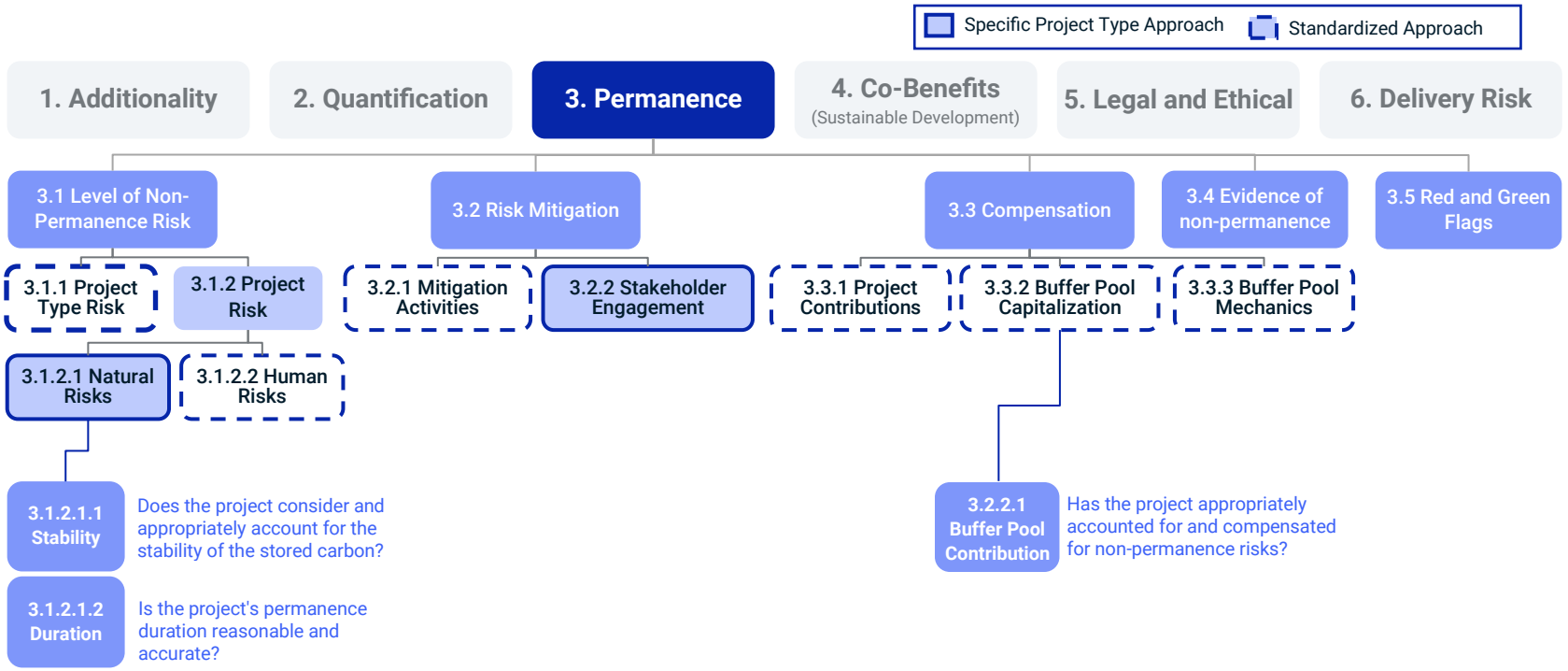
Engineered carbon dioxide removals, including methods like biochar, have the potential to sequester carbon for long periods. Recent scientific studies have revealed more insights on this topic. In particular, they have identified how the stability and duration of the removal can be subject to some risk of carbon loss, particularly over a 100- or 1,000-year timeline, with the carbon stability highly dependent on several parameters like process type, temperature and type of biomass used.[7]

Key characteristics and metrics to assess the permanence efficiency of biochar removal projects include not only direct natural risks but also carbon loss related to the stability of the biochar and the duration of the removal. Such risks are highly dependent on the quality of the biochar (how stable is the embodied carbon), the end-use application (for example, soil application versus construction) and the respective stability of that application combined with the potential duration. To accurately assess the risk of reversals for biochar projects, it is therefore essential to consider and account for both biochar stability and duration.

Figure 8: Permanence integrity assessment approach illustrates the sub-criteria through which MSCI ESG Research assesses the permanence of the emissions reductions achieved by biochar projects, and the Integrity Assessment framework sub-criteria that they refer to. The detailed sub-criteria are described in Figure 9.

[7] Lefebvre, David, et al. "Biomass Residue to Carbon Dioxide Removal: Quantifying the Global Impact of Biochar."

Figure 8: Permanence integrity assessment approach[8]



[8] The approach to assess 3.2.2 Local Stakeholder Engagement is outlined in Section 4.3.2, Local Stakeholder Engagement.

Figure 9: MSCI ESG Research Permanence integrity assessment framework

Sub-criteria		Metrics	Rationale	REDD+	Renewables	ARR	Cookstoves	Biochar	Landfill Gas	Safe Water	IFM	Waste Mgmt.	Blue Carbon
3.1 Level of Non-Permanence Risk	3.1.1 Project Type Risk	Project Type Significance	Different project types have inherently different levels of non-permanence risk.	✓ *Standardized approach*									
3.1 Level of Non-Permanence Risk	3.1.2 Project Risk	3.1.2.1 Natural Risks	The risk of fire, drought, landslide and other natural risks in that project area.	✓		✓					✓		✓
3.1 Level of Non-Permanence Risk	3.1.2 Project Risk	3.1.2.2 Human Risks	Human-related permanence risks include the strength of land tenure rights or a project developer's experience.	✓		✓					✓		✓
3.2 Mitigation		3.2.1 Mitigation Activities	Projects can mitigate non-permanence risks through implementing activities that focus on addressing key risks.	✓		✓	✓	✓		✓	✓		✓
3.2 Mitigation		3.2.2 Local Stakeholder Engagement	Successfully engaging with local stakeholders lowers the risk of human-based non-permanence.	✓		✓	✓	✓		✓	✓		✓
3.3 Compensation and Contributions		3.3.1 Project Contributions	A project's buffer pool contributions should appropriately account for the non-permanence risk.	✓		✓	✓	✓		✓	✓		✓
3.3 Compensation and Contributions		3.3.2 Buffer Pool Capitalization	An under-capitalized buffer pool may have insufficient credits to cover future losses.	✓ *Standardized approach*									
3.3 Compensation and Contributions		3.3.3 Buffer Pool Mechanics	A buffer pool should have mechanisms in place to ensure projects appropriately account for and estimate their buffer pool credits.	✓ *Standardized approach*									
3.4 Evidence of Non-Permanence		Non-Permanence Events	If significant reversals have occurred without being accounted for, then carbon stock reversals have already occurred.	✓		✓					✓		
3.5 Red and Green Flags		News scanning	Review of academic papers, industry sources and the news for Red or Green Flags relating to project's permanence.	✓ *Standardized approach*									

3.1.2.1.1 Stability

Biochar can be stored in multiple different end applications, with soil currently the most common, followed by construction and land remediation. Biochar can also be applied as an animal feed additive or within filtering applications, though the research around carbon stability for these types of applications is less rigorous.

The inherent stability of these end applications can vary significantly. The stability of the end application must be appropriately accounted for to monitor and quantify the permanence of the stored carbon. To assess the carbon storage stability of a project, two main sub-criteria are considered:

- **3.1.2.1.1.1 Permanence Methods:** Whether the project appropriately monitors and quantifies the stability of the stored carbon using proven scientific methods.
- **3.1.2.1.1.2 End Application Stability:** Whether the end application represents a high stability destination to store the biochar.

Each of these sub-criteria is assessed on a 1-5 scale, with the overall score reached by weighting 3.1.2.1.1.1 Permanence Methods 50% and 3.1.2.1.1.2 End Application Stability 50%.

3.1.2.1.1.1 Permanence Methods

Permanence Methods refers to the methods used by the project to appropriately monitor and quantify the stability of the stored carbon using up to date and proven scientific methods.

Rationale	There are a number of scientific methods approved by academia and industry alike that can be used to measure and monitor the stability of the carbon structure embodied in biochar. The hydrogen to organic carbon ratio is widely accepted as a good indicator of stability, but there are a number of other methods available. Projects that use scientifically approved methods or a combination of methods increase the accuracy and reliability of their estimations and assumptions.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑		☑	☑	☑	
Scoring Definition	Each project is scored on a 5-point scale from 1 to 5 for each risk type, where 1 indicates that the project either does not provide the methods and data to justify its permanence claims and 5 indicates that the project provides a combination of rigorous methods supported by data relevant to the specific end application.					
Scoring Approach	MSCI ESG Research conducts detailed research on the most scientifically best-practice methods including industry, academic and third-party literature data.[9] Through this research, the relative accuracy of each method is assessed. This is then combined with a comprehensive review of both the individual project's approach and the relevant methodological requirements. In addition, data is collected on whether projects provided information on five key factors: i) H:C ratio; ii) permanence factor; iii) soil temperature; iv) technology type; v) location. Projects are then assessed based on the methods used, through creating a correlation of the H:C ratio values with carbon stability (correlation values lower than 0.1 are indicative of higher biochar permanence).					

[9] Yaashikaa, P. R., et al., "A Critical Review on the Biochar Production Techniques, Characterization, Stability and Applications for Circular Bioeconomy."

Projects that provide all of the key methods and data relevant to each application combined with a low H:C ratio score a 5. Otherwise, projects are then scored on a 1 to 5 scale based on which data points were disclosed and/or methodologically required.

3.1.2.1.1.2 End Application Stability

End Application Stability refers to whether the end application inherently represents a highly stable destination to store or use the biochar.

Rationale	The carbon storage stability of the end application can vary significantly across different end applications. Certain applications, such as construction materials (aggregates, building materials, asphalt and cement) present near zero risk of carbon loss through the length of the storage duration, whereas soil or animal feed applications do carry risk of carbon loss due to decay or devolatilizing back into to the environment. Carbon stored in end applications that have higher stability will have lower permanence risks and provide a secured duration.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑			☑	☑	

Scoring Definition	Each project is scored on a scale of 3 to 5, where 3 indicates an application with higher risk of stored carbon loss and 5 indicates a very stable end application destination.
Scoring Approach	MSCI ESG Research conducts a detailed review of each individual project's key documents to identify the end application of the biochar. This is then combined with a review of academic literature to understand the scientific consensus regarding the stability of each end application. Projects are then scored on a 3 to 5 scale based on the stability of the end application that they use.

3.1.2.1.2 Permanence Duration – Lifetime

The duration of the biochar within the end application must be appropriately and reasonably estimated by projects. Duration is not a binary concept for biochar; it is possible for a proportion of biochar to be released back in the environment over the storage duration period, meaning one must evaluate how much biochar will be persistent over a certain lifetime.

As part of our assessment of duration, both the accuracy of the project's claimed duration and the likelihood of duration over a 100-year timeframe are considered. Primarily basing the assessment on a 100-year timeframe allows for more direct comparison of biochar permanence against other project types.

Three main sub-criteria are considered as part of this assessment:

- **3.1.2.1.2.1 Accuracy of Duration Claims:** Whether the project's duration claims appear accurate and reasonable given the biochar properties, risks and conditions on the project application.

- **3.1.2.1.2.2 100-year Lifetime:** The extent to which the biochar will be persistent over a 100-year lifetime.
- **3.1.2.1.2.3 Other Permanence Risks:** Whether any other permanence risks exist that may impact the duration of the stored carbon.

Each of these sub-criteria is assessed on a 1-5 scale. To ensure comparability with other project type integrity scores, which have primarily been assessed on a 100-year permanence timeline, 100-year Lifetime is weighted 85%, Accuracy of duration claims 10% and Other permanence risks 5%.

3.1.2.1.2.1 Accuracy of Duration Claims

Accuracy of Duration Claims refers to whether the project's duration claims appear accurate and reasonable given the biochar quality, properties and specific characteristics of the application location.

Rationale	Each project's stated carbon storage duration claims vary significantly depending on the project scope and biochar quality. Conservative storage duration claims that are realistically achievable combined with a justifiable approach relative to each application improve the accuracy and reliability of the assumptions and estimates.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑			☑	☑	

Scoring Definition	Each project is scored on a scale of 1 to 5, where 5 indicates that the stored carbon duration for the specific application is highly accurate and 1 indicates the stated duration has a higher risk of not being overestimated.
Scoring Approach	MSCI ESG Research completes a detailed review of each individual project's key documents to extract the application type and stated storage duration in years. This is then combined with a detailed review of academic literature to compare these assumptions against third-party estimates. Projects are evaluated based on 50-year intervals up to 200 years and then 500- and 1,000-years mark and correlated the project duration to each specific application. Construction, for example, does not present significant risks however it is limited due to the lifetime of the structures which is considered a maximum of 200 years. Specifically, for soil application, the type of biochar, soil temperature range and impact on the permanence factor over a 1,000-year period is considered, and the overall stored carbon loss percentage is evaluated and incorporated in the scores. More information on the expected carbon loss depending on these factors is provided in Section 9. For non-soil applications, projects are scored based on the type of end application and the stated storage duration. For soil applications, projects are scored on a 1 to 5 scale based on their pyrolysis type and average soil temperature range for their location.

3.1.2.1.2.2 100-year Lifetime

100-year Lifetime relates to the durability of the embodied carbon in the biochar and its persistence over a 100-year timeframe.

Rationale	The 100-year reference value has been selected an indicator of permanence duration for a project's stated permanence duration claims. Projects that produce high quality biochar combined with a secure end application can secure sufficient reliability for the stored carbon to persist within the 100-year lifetime.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑			☑	☑	☑

Scoring Definition	Each project is scored on a scale of 1 to 5, where 5 indicates that the stored carbon duration for the specific application is highly accurate and 1 indicates the stated duration has a higher risk of not being overestimated.
Scoring Approach	A thorough project documentation review is completed to extract values for key project parameters like biochar quality and stated end-application. Individual project stated values assumptions are then compared with third-party data and estimates made by academic literature studies for the proportion of carbon loss expected over a 100-year duration. Specific project characteristics are considered such as the stability of the biochar and percentage of carbon loss over the stated lifetime for different soil temperatures. Specifically, for soil application, the type of pyrolysis, soil temperature range and impact on the permanence factor over a 100-year period is considered. More information on the expected carbon loss depending on these factors is provided in Section 9.

3.1.2.1.2.3 Other Permanence Risks

Other Permanence Risks relate to whether any other non-permanence risks exist that may impact the duration of the stored carbon.

Rationale	A project located in an area which has a higher cumulative risk resulting from natural factors like wildfire, draught or flood that results in higher overall risk of carbon loss due to the damage that can done to the end application.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑	☑			☑	

Scoring Definition	The permanence risk of each of area was scored on a 1 to 5 scale based on a comparison of a project's location and applicable risks against our third-party calculated risk values.
Scoring Approach	A project documentation review is completed to extract data on the stored biochar location and the stated end-application. For projects where information on the exact stored location is identified, our geospatial team modelled the fire, drought and flood risk relevant for that location. For projects where specific information on the location of

the storage is not available, third-party data from the International Energy Agency and ThinkHazard for the relevant country-level risk are used.

Three main elements of risk are considered:

1) **Flood risk** impacting the potential leakage of material into water bodies.
2) **Drought risk** relating to increased temperature devolatilization of the stored carbon.
3) **Wildfire risk** that could lead to release of the stored carbon back into the environment.

The overall score is then based on an average of these three risk scores.

8. Criterion 4 – Co-benefits

Co-benefits reflect the sustainable development benefits (and safeguards) of a project beyond the CO_2e it saves, in other words its "externalities." These environmental and societal externalities are typically positive but can, on occasion, be negative.

Carbon projects have the potential to reduce/remove CO_2e, and simultaneously have a broader positive societal impact via issues such as development, adaptation, and biodiversity.

Biochar projects have the potential to deliver significant social and environmental benefits outside of their emissions impact. On the environmental side, when applied to soil, biochar can significantly improve soil health, which can act as the foundation for a more diverse and richer ecosystem. Further, through improving soil health, biochar projects can improve the agricultural yield of land and reduce the need for fertilizer usage, therefore improving the economic outcomes of some farmers.

Our approach to co-benefit assessment builds on the UN's Sustainable Development Goals (SDG) framework. We focus on understanding both the SDG significance of a project and the extent to which the project provides evidence of these outcomes being achieved through effective monitoring.

Figure 10 illustrates the sub-criteria through which MSCI ESG Research assesses the co-benefits of biochar projects, and the Integrity Assessment framework sub-criteria that they refer to. The detailed sub-criteria are described in **Figure 11**.

Figure 10: Co-benefits integrity assessment approach

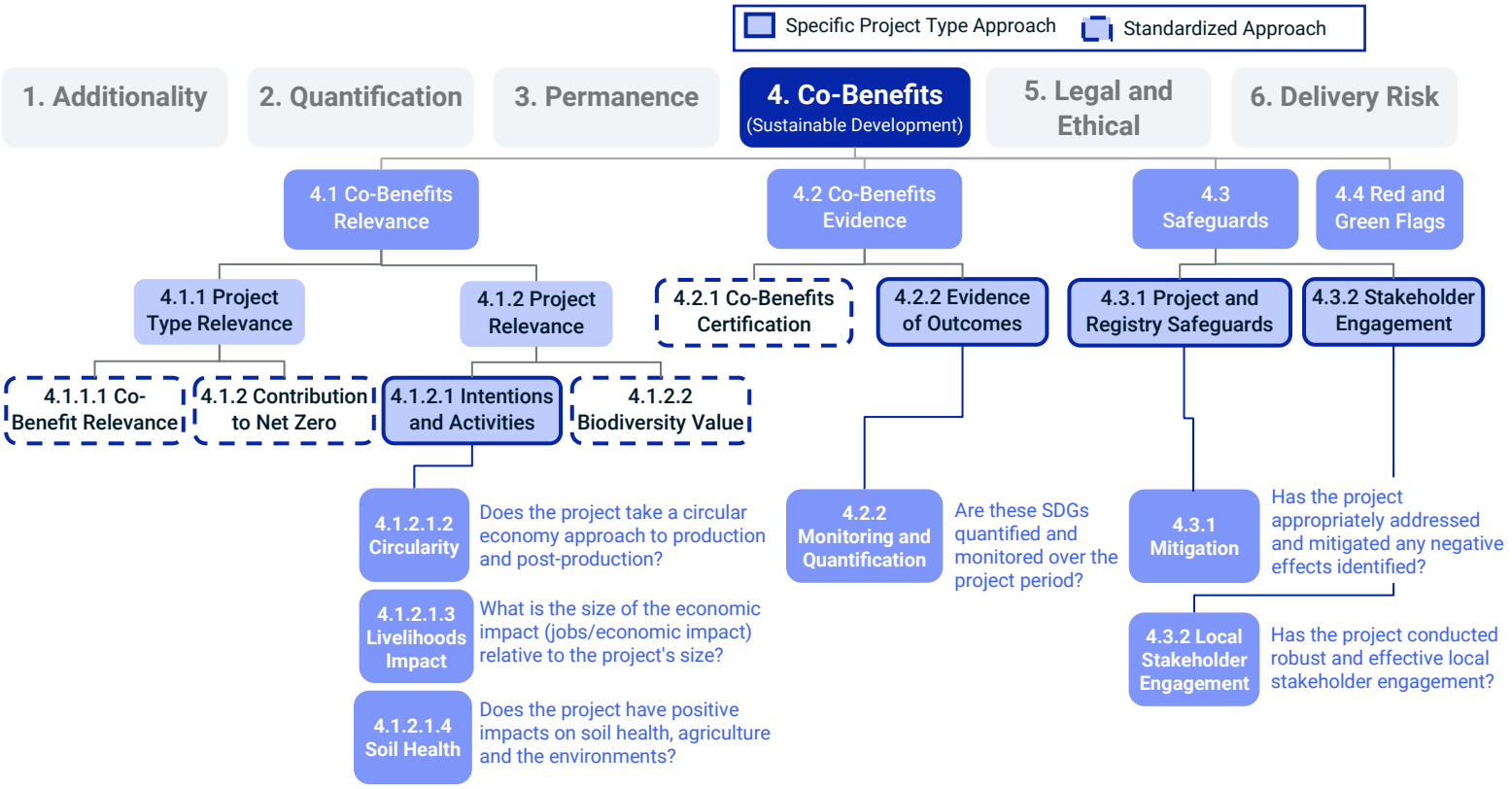


Figure 11: MSCI ESG Research Co-benefits integrity assessment framework

Sub-criteria		Metrics	Rationale	REDD+	Renewables	ARR	Cookstoves	Biochar	Landfill Gas	Safe Water	IFM	Waste Mgmt.	Blue Carbon
4.1 Co-benefits Relevance	4.1.1 Project Type Relevance	4.1.1.1 Relevance to Project Type	Different project types have an inherently different impact on each sustainable development impact.	✓ *Standardized approach*									
		4.1.1.2 Contribution to Net Zero	Some project types create "carbon lock-ins" of technologies or practices that are not compatible with a net zero economy.	✓ *Standardized approach*									
	4.1.2 Project Relevance	4.1.2.1 Project Intentions to Activities	The specific design and implementation of a project's activities are critical drivers for whether a project generates positive sustainable development impact.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		4.1.2.2 Biodiversity Value	Nature-based projects that enhance or protect areas of rich biodiversity have greater environmental value.	✓		✓					✓		✓
4.2 Co-benefits Evidence		4.2.1 Certification	Achieving certification involves more stringent project verification. This improves the likelihood that a project's co-benefits have been realized.	✓ *Standardized approach*									
		4.2.2 Quantification of Outcomes	Projects can increase the evidence that co-benefits are attributed to their actions through measuring, monitoring, and quantifying the outcome.	✓		✓	✓	✓		✓	✓		✓
4.3 Safeguards		4.3.1 Project and Registry Safeguards	More effective environmental and social safeguards reduce the likelihood of projects causing harm.					✓					
		4.3.2 Local Stakeholder Engagement	Projects that successfully engage with local stakeholders reduce the likelihood of any negative impacts occurring.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4.4 Red and Green Flags		News scanning	Review of academic papers, industry sources and the news for Red or Green Flags relating to project's co-benefits.	✓ *Standardized approach*									

4.1.2.1 Project Intentions to Activities

While biochar projects can impact a range of social or environmental goals, the significance of these co-benefits is heavily determined by the design of the production process, the properties of the biochar and its end application. A deep understanding of a project's activities and the biochar properties is therefore required in order to fully assess its co-benefit impact.

There are four categories of sustainable development impacts that are evaluated as part of this sub-criterion:

- **4.1.2.1.1 Target SDGs:** Whether the project claims and targets a significant number of sustainable benefits, either SDGs or other benefits.
- **4.1.2.1.2 Circularity:** Whether the project supports more sustainable production through taking a circular approach to production and post-production.
- **4.1.2.1.3 Livelihoods Impact:** Whether the project supports and invests in local jobs and infrastructure.
- **4.1.2.1.4 Soil Health:** Whether the project positively directly impacts soil health, and indirectly improves agriculture and ecological wellbeing through these outcomes.

Each project is scored on a scale of 1 to 5 based on the evaluation of these metrics. Target SDGs is weighted 5%, Circularity 25%, Soil Health 50% and Livelihoods Impact 25%.

4.1.2.1.1 Target SDGs

Target SDGs refers to whether the project claims, and targets, a significant number of sustainable benefits, either SDGs or others.

Rationale	Aside from its emissions impact benefits, biochar has many other co-benefits that align with, and contribute to, the sustainable development goals. Project developers that clearly state and target certain development impacts can more appropriately ensure that their design is well set-up to achieve these outcomes.
Key Sources	Project Documentation ☑ | Geospatial | Project Methodology Documentation | Academic Literature | Third-party Data | MSCI Carbon Markets
Scoring Definition	Each project is scored on a scale of 1 to 5, where 1 indicates no benefits other than carbon removals have been mentioned, and that no SDGs have been referred to; 3 indicates that at least 5 benefits have been listed, whether SDGs or other benefits specific to the project; 5 indicates that 10+ benefits have been listed, whether SDGs or other project co-benefits.
Scoring Approach	MSCI ESG Research conducts a detailed review of each project's key documents to identify all the sustainable benefits of biochar application either explicitly or implicitly mentioned. These benefits tend to differ depending on the end-use, for example, when applied as a feed additive, biochar can aid the reduction of methane emissions, and improve water filtration, which contributes to SDG 6: Clean water and sanitation. As many projects do not directly use SDGs (sustainable development goals), all sustainable development impacts implicitly mentioned are also considered. The score for each project is based on the total number of benefits (either SDGs or sustainable development impacts) identified, and scaled on a 1 to 5 basis.

4.1.2.1.2 Circularity

Circularity relates to whether the project supports more sustainable production through taking a circular approach.

Rationale	The production of biochar can "close the gap" of production, by using a waste feedstock and producing several important by-products, which can be re-used during the pyrolysis stage. Projects that use a supply of waste biomass inputs support a more circular approach than those that do not, and therefore contribute to more sustainable production.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑					

Scoring Definition	Each project is scored on a scale of 1 to 5, where 1 indicates no proof of a circular approach and 5 indicates that waste feedstock has been used to create biochar and byproducts have been reused during the process, and that these has been quantified.
Scoring Approach	MSCI ESG Research conducts a detailed review of each individual project's key documents to identify three main circular approach characteristics: i) the source of the feedstock, ii) any by-products that were created during the process, and iii) whether the by-products were re-used. This is then combined (where available) with project data on the proportion of renewable electricity/syngas reused with third party literature to deduce what is best practice in terms of circularity.

4.1.2.1.3 Livelihoods Impact

On top of the impacts on agricultural yields and agricultural income, biochar projects can also support superior livelihoods for the local community through its support for local jobs and infrastructure.

To assess a project's impact on livelihoods, two sub-criteria are considered:

- **4.1.2.1.3.1 Job Creation:** Whether the project supports material job creation through the life cycle of the project.
- **4.1.2.1.3.2 Community Impacts:** Whether the project directly or indirectly shares the proceeds of the carbon credits with the local community either through benefit sharing or investments in local infrastructure.

Each of these sub-criteria is assessed on a scale of 1 to 5, with the overall score based on a weighting of each. 4.1.3.3.1 Job Creation is weighted 35% and 4.1.3.3.2 Community Impacts is weighted 65%.

4.1.2.1.3.1 Job Creation

Job Creation relates to whether the project supports material job creation through the life cycle of the project.

Rationale	Biochar is a nascent industry and has the potential to create jobs and training opportunities within its project. While most biochar projects will inherently support some job creation in the construction and production process, projects that measure and report this improve the transparency on the size of this outcome.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑					
Scoring Definition	Each project is scored on a 1 to 5 scale, where 5 indicates that over 150 jobs have been provided, or that over 5 jobs per kt CO_2e removed have been created; 3 indicates that either over 60 jobs have been provided, or that one job or more has been created for each kt CO2e removed; and 1 indicates that the project has not provided information on jobs provided.					
Scoring Approach	MSCI ESG Research conducts a detailed review of each individual project's key documents to collect employment data, accounting for if employment was created, and if this was quantified. This is then combined with the number of carbon credits created, if stated, to deduce the number of jobs per kt CO_2e removed. Projects are then scored on a 1 to 5 scale based on the employment potential that they provide. Alongside this, the number of jobs is weighed against the number of carbon credits that the project creates, in order to scale the creation of work into jobs per kt CO2e removed.					

4.1.2.1.3.2 Community Impacts

Community Impacts relates to whether the project directly or indirectly shares the proceeds of the carbon credits with the local community either through benefit sharing or investments in local infrastructure.

Rationale	Biochar projects have the potential to improve the livelihoods of local communities and farmers, by offering local employment, creating economic development, and by subsidizing biochar for farmers who are often not in the financial position to afford to buy it.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑					
Scoring Definition	Each project is scored on a 1 to 5 scale, where 5 indicates that the project explicitly creates economic development, provides local employment and ensures that biochar reaches local communities; 3 indicates that one of these three factors had been met; and 1 indicates that no data has been provided.					
Scoring Approach	MSCI ESG Research collects qualitative data on benefit sharing. The presence and relevance of three factors related to the economic impact of the projects are identified: i) whether it has supported local economic development; ii) whether it directly supports local community initiatives; iii) whether it directly supports local employment.					

4.1.2.1.4 Soil Health

Biochar is regularly stored in soil applications. The storage of biochar within soil can significantly impact (and positively improve) the health of the soil, leading to numerous second-order benefits.

Over 90% of biochar projects analyzed so far are used as a soil amendment, as their primary or secondary end use. This criterion is therefore only relevant for a portion of projects, albeit the vast majority.

To assess a project's impact on soil health, three sub-criteria are considered:

- **4.1.1.4.1 Direct soil benefit:** Whether the project directly targets soil benefits, and whether this aligns with the feedstock used in connection with the end use.
- **4.1.1.4.2 Inherent soil benefit:** Whether the project will inherently produce soil benefits from the biochar application given the feedstock used, and soil type.
- **4.1.1.4.3 Agricultural yields and fertilizer:** Whether the project positively impacts crop yields and fertilizer usage through its application to soil.

Each of these sub-criteria is assessed on a scale of 1 to 5, with the overall score based on a weighting of each. 4.1.3.2.1 Direct soil benefit is weighted 45%, 4.1.3.2.2 Inherent soil benefit is weighted 35% and 4.1.3.2.3 Agricultural yields and fertilizer is weighted 20%.

4.1.2.1.4.1 Direct soil benefit

Direct soil benefit refers to whether the project directly targets soil benefits, and whether this aligns with the feedstock used in connection with the end-use.

Rationale	Biochar has the potential to have significant positive effects on soil health. Projects that target these benefits and ensure that the targets are appropriately aligned to the feedstock used will maximize the potential for these impacts to be realized.

Key Sources

Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
☑			☑		

Scoring Definition	Each project is scored on a 1 to 5 scale, where 5 indicates that the feedstock used is suitable for the end-use of the biochar, and that multiple soil health qualities have been listed; 3 indicates that either the feedstock is suitable for the end-use but fewer soil health qualities have been mentioned, or that the feedstock is not suitable for the end-use but this has been offset by assurance of soil health factors; and 1 indicates that the project's feedstock is not suitable for the end-use and there is little evidence of soil health improvement.
Scoring Approach	MSCI ESG Research extracts information on which types of soil health benefits projects target and measure, focusing on five main potential benefits: i) increased cation exchange; ii) greater nutrient capacity; iii) increasing soil pH; iv) improved water retention capacity; v) reduction of reliance on fertilizer. The number of impacts targeted and measured by projects are counted, with projects categorized into 3 main groups based on this count: 0 benefits, 1-4 and 5+. This is then sense-checked by using academic references to ensure that each benefit mentioned is relevant and suitable based on the feedstock and end-application. The overall score is then based on the suitability of the feedstock type for the end application and the evidence provided by the project on the soil health benefits.

4.1.2.1.4.2 Inherent soil benefit

Inherent soil benefit refers to whether the project will inherently produce soil benefits from the biochar application given the feedstock used, and soil type.

Rationale	The impacts of biochar on soil health depend significantly on both the type of feedstock used and soil type in which the biochar is stored. Certain combinations of feedstock type and soil type will have inherently higher benefits on soil health than other combinations.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑	☑		☑		

Scoring Definition	Each project is scored on a 1 to 5 scale, where 5 indicates that the feedstock used is highly suitable for the type of soil that the biochar is applied in and likely to generate significant benefits; 3 indicates that either the feedstock is not suitable for end use in that soil type, or that the type of soil sees less positive results from biochar application; and 1 indicates that the feedstock is not suitable for the type of soil it is utilized in.
Scoring Approach	MSCI ESG Research extracts information on the feedstock being used in each project, grouped these into the following categories: agricultural residues, wood residues, forestry waste, organic waste, industrial waste, dedicated energy crops and manure. The soil type is then categorized as fertile, semi-fertile or arid, based on an updated data set of the Köppen-Geiger classifications of the five climate types, which are then mapped to the country of the project. Each project is then scored on a 1 to 5 scale based on these two factors.

4.1.2.1.4.3 Agricultural yields and fertilizer

Agricultural yields and fertilizer relates to whether the project positively impacts crop yields and fertilizer usage through its application to soil.

Rationale	Projects should account for the amount of fertilizer reduction that biochar application allows, as well as the yield increase. Quantifying this allows the project to exemplify the co-benefits that the biochar is having.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑			☑		

Scoring Definition	Each project is scored on a 1 to 5 scale, where 5 indicates that the project has quantitatively estimated significant increases in yields and reductions in fertilizer, while 1 indicates that there would be no positive effect on agricultural yield or fertilizer reduction.

Scoring Approach	The approach to assessing this sub-criterion analyses both agricultural yield and fertilizer usage. Through a detailed review of project documentation, MSCI ESG Research compiled information on both issues. Based on various academic studies, projects that did not quantify a yield increase are assumed to have a minimum 5% yield increase.[10] Projects that did state fertilizer reduction but did not quantify this were assumed to have a minimum 5% fertilizer reduction. Projects that did not state or quantify fertilizer reduction were assumed to have a minimum 3% fertilizer reduction, based on assumptions informed by academic sources. The overall score was then based on an equal weighting of both factors. If only one was available, then the score for this factor was taken.

4.2.2 Quantification of Outcomes

Quantification of outcomes relates to whether the project monitors and/or quantifies the impact of the project on targeted sustainable development goals.

Rationale	Assessing the evidence of co-benefit impacts is crucial to evaluating the degree to which these can be attributed to a project. Projects that measure, quantify, and monitor their co-benefit impacts provide greater evidence in support of their targeted social and environmental effects.					
Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑					
Scoring Definition	Each project is scored on a scale of 1 to 5, where 1 indicates there is no quantification or monitoring of SDGs and 5 indicates that benefits are quantified and monitored.					
Scoring Approach	MSCI ESG Research assesses the level to which co-benefits have been quantified and/or monitored.					

4.3.1 Project and Registry Safeguards

Since biochar projects do not have a comprehensive amount of data publicly available, a baseline level of mitigation for potential negative impacts is necessary, to ensure that nothing has slipped through the cracks of the integrity assessment.

This is evaluated through the following sub-criteria:

[10] Campion, L., Bekchanova, M., Malina, R., Kuppens, T., (2023) "The costs and benefits of biochar production and use: A systematic review," Journal of Cleaner Production, Volume 408, 2023, 137138, ISSN 0959-6526. [https://doi.org/10.1016/j.jclepro.2023.137138]; Zilberman, D., Laird, D., Rainey, C., Song, J., & Kahn, G. (2023). "Biochar supply-chain and challenges to commercialization." GCB Bioenergy, 15, 7-23. https://doi.org/10.1111/gcbb.12952.

- **4.3.1.1 Certifications:** Whether the project received European Biochar Certificate (EBC) or International Biochar Initiative (IBI) certification, and has clearly evidenced this
- **4.3.1.2: Negative impacts mitigation:** Has the project mitigated negative effects adequately?

Each of these sub-criteria is assessed on a scale of 1 to 5, with the overall score based on a weighting of each.

4.3.1.1 Certification

Certifications refer to whether the project received EBC or IBI certification and has clearly evidenced this.

Rationale	There are several internationally renowned certifications for biochar, which are only awarded for the best quality standards and involve rigorous sampling and monitoring. Projects that have received EBC and/or IBI certification are more likely to have good quality environmental safeguards in place.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑				☑	

Scoring Definition	Each project is scored on a 2 to 5 scale, where 5 indicates that certification has been mentioned and certified, while 2 indicates no certification appears to have yet been received.
Scoring Approach	MSCI ESG Research reviews EBC standards to assess which projects had or had not received this certification. Projects are then scored based on the presence of these certifications.

4.3.1.2 Negative impacts mitigation

Projects own self-assessment of potentially negative impacts is integral to a good project, in order to ensure that these are avoided.

Rationale	Projects should ensure that the process of producing biochar is carefully managed to ensure a positive outcome. They should also be aware of the end use of their biochar product, ensuring that it is well-suited to this use.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑					

Scoring Definition	Each project is scored either 1 or 5, where 1 indicates there is no mitigation and 5 indicates that there is a clear mitigation procedure implemented by the project.
Scoring Approach	Through a comprehensive analysis of project documentation, MSCI ESG Research identify whether any potential negative impacts had been recognized and mitigated by the project through all parts of its processes: pre-processing account for the feedstock, the processing during pyrolysis, and the post-process end use of the biochar.

4.3.2 Local Stakeholder Engagement

Though biochar projects do not tend to be community-led, projects that put additional resources and time into consulting with their local communities and modifying their design/operations to suit locals are more likely to realize their social objectives.

This is evaluated through the following sub-criteria:

- **4.3.2.1 Effective Consultation:** How effective was the consultation conducted?
- **4.3.2.2 Representation and Inclusivity:** Has the project ensured proper and inclusive representation of stakeholders?
- **4.3.2.3 Access to Information:** Has the project relayed relevant information to stakeholders?
- **4.3.2.4 Feedback and Grievances:** Does the project display effective feedback and grievance redressal mechanisms?

Each project is scored on a 1 to 5 scale for each of these sub-criteria. An overall score for criterion 4.3.2 is then reached by weighting effective consultation and representation and inclusivity by 35% each and access to information and feedback and grievance 15% each. Projects scoring a 5 will represent projects that undertake detailed stakeholder consultations that are representative of the target users.

4.3.2.1 Effective Consultation

Effective consultation relates to whether the project uses best-practice techniques to engage and consult with stakeholders.

Rationale	Projects that engage with stakeholders towards the start of a project's conception and use multiple methods of in-person consultation provide more open and effective channels to engage with stakeholders and receive any feedback.
Key Sources	Project Documentation ☑ | Geospatial | Project Methodology Documentation | Academic Literature | Third-party Data | MSCI Carbon Markets
Scoring Definition	Each project is scored on a scale of 1 to 5 scale, where 5 indicates that the project appeared to conduct effective in-person engagements prior to its start, and 1 indicates that very limited in-person stakeholder consultation seemed to have been performed prior to the start of the project or thereafter.
Scoring Approach	Through a detailed review of key project documents, three main components of stakeholder consultation effectiveness are assessed. First, the initial date of stakeholder consultation is compared to the project start date. Second, the types and range of consultation conducted are considered. Third, the frequency that ongoing consultation is conducted is assessed.

4.3.2.2 Representation and Inclusivity

Representation and Inclusivity relates to whether the project has ensured that it consults with a representative and inclusive range of stakeholders.

Rationale	Projects which consult a greater number of stakeholders tend to incorporate more representative feedback and ensure that they are designed with a representative set of stakeholder interests in mind.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑					

Scoring Definition	Each project is scored on a scale of 1 to 5, where 5 indicates that a project transparently consults with a representative group of stakeholders, including women, while 1 indicates that no information is provided on the which stakeholders were consulted.
Scoring Approach	MSCI ESG Research assesses the number of stakeholders in attendance, and the proportion of stakeholders that are male and female.

4.3.2.3 Access to Information

Access to Information refers to whether the project provides transparent and comprehensive information to (local) stakeholders regarding its activities.

Rationale	By providing greater access to information, stakeholders will be better informed on a project's activities and more able to provide feedback to the project.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑					

Scoring Definition	Each project is scored on a scale of 1 to 5 scale, where 5 indicates that a project provides very transparent access to information through both documentation and in-person meetings, and 1 indicates that limited access to information is provided to stakeholders.
Scoring Approach	MSCI ESG Research conducts a detailed review of relevant project documentation to understand whether in-person meetings were conducted to present project information or whether clear documentation was/is provided.

4.3.2.4 Feedback and Grievance

Feedback and Grievance refers to whether the project has procedures in place to receive and act on feedback received from stakeholders.

Rationale	By providing (local) stakeholders with a clear feedback mechanism and committing to disclose and act on this feedback, then projects are more likely to satisfy the needs of stakeholders by both listening and responding to their feedback.

Key Sources	Project Documentation	Geospatial	Project Methodology Documentation	Academic Literature	Third-party Data	MSCI Carbon Markets
	☑					
Scoring Definition	Each project is scored on a scale of 1 to 5 scale, where 5 indicates that a project provides very transparent access to information through both its documentation and the holding of in-person meetings, and 1 indicates that stakeholders appear to have only limited access to information.					
Scoring Approach	Three aspects of a project's feedback procedure are assessed: - **Feedback Mechanism:** Whether a project has a feedback and grievance procedure in place. - **Feedback Disclosure:** Whether a project transparently discloses any feedback received. - **Feedback Response:** Whether a project has clearly acted on any feedback received.					

9. Appendix – Soil Application Permanence

Biochar removals are generally considered to have a high permanence. But some carbon is lost over time. The pace of carbon loss depends primarily on the pyrolysis temperature and soil temperature: a high pyrolysis and low soil temperature results in the greatest permanence/lowest rate of carbon loss.

Based on academic sources[11], the estimated carbon loss for projects with different characteristics is shown in Figure 12.

Figure 12: Estimated carbon loss over different time periods based on the biochar pyrolysis and soil temperature

% Carbon Loss		100-year Duration			500-year Duration			1,000-year Duration		
		Soil Temperature								
		5°C - 10°C	10°C - 15°C	15°C - 25°C	5°C - 10°C	10°C - 15°C	15°C - 25°C	5°C - 10°C	10°C - 15°C	15°C - 25°C
Pyrolysis Temperature	High Stability (400°C+)	6%	12%	18%	37%	50%	60%	57%	69%	77%
	Medium Stability (300-400°C)	10%	18%	25%	45%	57%	66%	64%	73%	79%
	Low Stability (<300°C)	12%	21%	30%	54%	65%	71%	70%	90%	95%

Increasing Risk (↓)

Increasing Risk → | Increasing Risk → | Increasing Risk →

[11] Woolf, Dominic, et al (2021). "Greenhouse Gas Inventory Model for Biochar Additions to Soil." Environmental Science & Technology, vol. 55, no. 21, Nov. 2021, pp. 14795–805, https://doi.org/10.1021/acs.est.1c02425.

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11. Change log

Date	Key Changes
19-Sep-2024	Initial publication
	-

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