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Sustainable Agricultural Biomass Sourcing for CDR

A BUYER'S GUIDE

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LEAD AUTHOR

SIGNATORIES

We welcome additional signatories in this collective effort to advance the market toward sustainable biomass sourcing.

This guide is the result of collaboration between buyers, CDR project developers, and experts convened by Carbon Direct. It is meant as a practical tool for contracting in CDR agreements. This report echoes the collective understanding of the Signatories. The Signatories acknowledge the potential role of biomass-based CDR within a portfolio of solutions for achieving net-zero emissions, even as the impacts of specific applications remain under exploration. Recognizing that the efficacy of biomass-based CDR critically depends on sustainable biomass sourcing, we highlight the urgent need for robust guardrails to avoid adverse outcomes. With appropriate standards and vigilance, biomass-based CDR can play an important role in limiting global warming to well below 2°C. The development of this guide involved in-depth consultations with an array of professionals, from corporate experts and academic scholars to representatives of international organizations, industry initiatives, CDR suppliers, and non-governmental organizations. The generous financial support of Microsoft Corporation facilitated the consultation process and the subsequent report. We extend our deepest appreciation to our knowledge partners and contributors for their invaluable input. Signatories endorse the overarching sentiments and arguments presented in this publication, but this should not be misconstrued as agreement with all details or recommendations.

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Introduction

Biomass-based carbon dioxide removal (CDR) is scaling rapidly. Pathways including bioenergy with carbon capture and storage (BECCS), biochar, and other biomass carbon removal and storage (BiCRS) approaches compose the majority of durable CDR available today. As buyers move from small purchases to multi-million-tonne commitments, deployment is poised to grow significantly over the coming decade. At the same time, biomass is a finite resource that already supports food systems, materials, energy, and emerging bioeconomy applications. Multiple decarbonization scenarios project that biomass demand will substantially exceed sustainable supply by mid-century (**figure 1**).[1] The need for clear, practical guardrails on biomass sourcing is increasingly salient.

Agricultural residues—crop residues like corn stover and wheat straw, as well as processing by-products like bagasse, rice husks, and seed meals—are positioned as a key feedstock category for scaling biomass-based CDR. Global assessments suggest that agricultural residues account for roughly one-third of sustainably available biomass,[2] and often perceive these materials as abundant, low-risk by-products of existing food production.

This perception can be misleading. Agricultural residues are often described as "waste," but when a material achieves sustained market demand, it is no longer waste—it is a feedstock with competing uses and system-level implications. Residues perform important ecological and economic functions within agricultural systems: they contribute to soil health, erosion control, nutrient cycling, and serve as livestock feed, local energy sources, and inputs to customary uses.[3, 4] Moreover, technical availability does not equal sustainable availability. Removing residues at scale can alter soil conditions, shift local resource access, and introduce governance challenges, particularly in regions where land tenure, residue ownership, or data quality are uncertain. High-level supply estimates rarely capture these risks.

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1. Energy Transitions Commission. 2021. Bioresources Within a Net-Zero Emissions Economy: Making a Sustainable Approach Possible. https://www.energy-transitions.org/publications/bioresources-within-a-net-zero-economy/
2. Energy Transitions Commission. Bioresources Within a Net-Zero Emissions Economy.
3. Fu B et al. 2021. Impacts of crop residues on soil health: a review. Environmental Pollutants and Bioavailability. 33(1):164–173. https://doi.org/10.1080/26395940.2021.1948354
4. Bentsen NS, Felby C, Thorsen BJ. 2014. Agricultural residue production and potentials for energy and materials services. Progress in Energy and Combustion Science. 40:59–73. https://doi.org/10.1016/j.pecs.2013.09.003

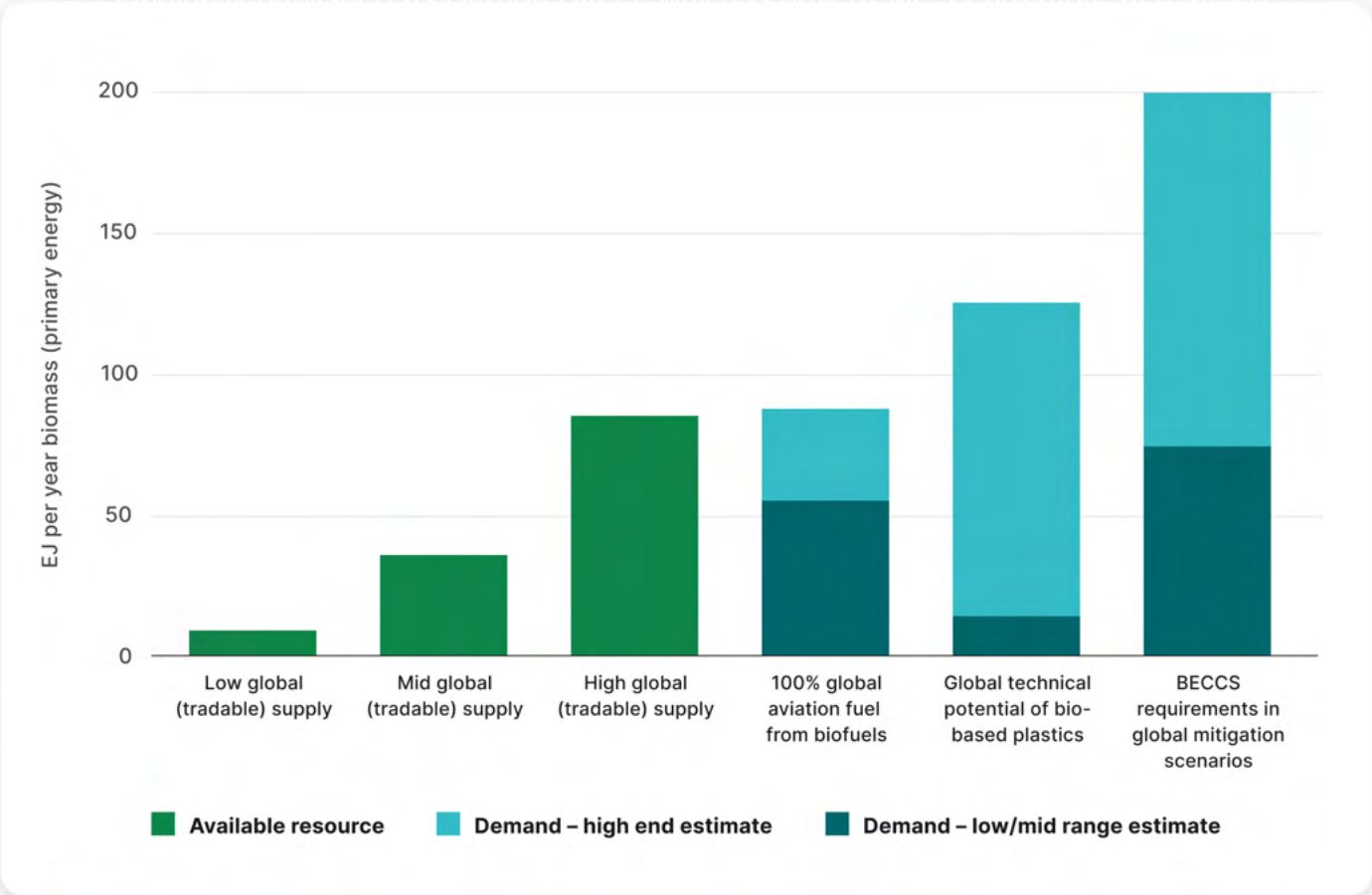

Figure 1. Potential demand outstrips supply of available biomass in high biomass-use scenarios by 2050. Note: EJ = exajoule. Source: Committee on Climate Change. 2018. Biomass in a Low-Carbon Economy.

Agricultural residue supply chains also tend to be structurally fragmented. In many regions, average farm sizes are small. This means that sourcing at scale involves large numbers of individual producers, often mediated through co-operatives, aggregators, or traders. This intermediary-heavy structure can obscure origin, complicate traceability, and make field-level verification difficult.

These dynamics underscore the need for a structured approach to agricultural residue sourcing that accounts for soil health, competing uses, land tenure complexity, and uneven monitoring capacity across regions. Existing sustainability standards (e.g., Roundtable on Sustainable Biomass, International Sustainability & Carbon Certification, International Organization for Standardization) provide relevant context but have limited coverage of agricultural residues for CDR applications, and no comprehensive global framework currently governs this space. Carbon Direct developed this guide to help fill that gap until relevant standards become widely adopted.

Focus of this guide

This guide provides a practical framework for sourcing agricultural residues in biomass-based CDR projects, with a particular focus on informing due diligence and contracting between CDR buyers and project developers. It is designed to support clearer risk allocation, documentation expectations, and sourcing safeguards in the context of rapidly scaling biomass demand. While the primary focus is on contracting applications, the guidance may also be informative for policymakers, researchers, and certification bodies working in adjacent areas.

This guide addresses:

- **Feedstocks:** This guide covers crop residues (e.g., corn stover, wheat straw, orchard prunings) and processing residues (e.g., bagasse, rice husks, seed meals, hulls).
- **Sourcing up to the facility gate:** This guide addresses biomass sourcing practices up to the point of delivery to a conversion facility.
- **Environmental and social risk identification:** This guide addresses environmental and community health impacts, competing uses, land tenure considerations, governance context, and the ability to monitor and verify sourcing practices.
- **Global application:** This guidance is intended to be applicable across diverse geographies, recognizing variation in governance capacity, corruption risk, land tenure systems, data availability, and monitoring infrastructure.
- **Practical implementation pathway:** This guidance is structured for near-term implementation in CDR contracting and project development.

This guide does *not* address:

- **Carbon accounting methodologies:** While closely related to sourcing, this guide does not explicitly evaluate crediting methodologies and lifecycle accounting frameworks.
- **Other feedstocks:** This guide does not cover other feedstocks such as animal wastes, municipal solid waste, purpose-grown energy crops, and forest biomass. Please see our previous guide on forest biomass.[5]
- **Downstream facility impacts and emissions:** Environmental justice considerations and point-source impacts beyond biomass sourcing are outside the scope of this document.

5. Carbon Direct. 2025. Sustainable Forest Biomass Sourcing for CDR: A Buyer's Guide. [accessed 2026 Mar 27]. https://www.carbon-direct.com/research-and-reports/2025-guide-to-sustainable-biomass-sourcing

- **Cascading use and cross-sector biomass prioritization:** This guide focuses on sourcing for CDR rather than evaluating trade-offs across competing uses of biomass in the broader bioeconomy.
- **Comprehensive global sustainability standards:** This guide does not replace emerging regulatory or certification frameworks and is intended to serve as an interim risk-management tool.

These issues are critical to the climate performance and societal impact of biomass-based CDR, but they require distinct analytical frameworks.

Core sourcing principles

The following core sourcing principles encompass the objective to reduce risk in biomass sourcing for biomass-based CDR projects. The principles are achieved through the satisfaction of specific criteria and implementation options.

1. Biomass must be traceable.
2. Biomass must come from sources with low risk of negative impacts on local communities, workers, vulnerable groups, and Indigenous Peoples.
3. Biomass must be sourced and managed in ways that minimize negative impacts on soil, including soil health, quality, and carbon stocks, and do not threaten protected areas.
4. Biomass must come from sources that do not distort markets for agriculture or forestry products.

Using the guide

The guide is not intended to replace standards or certification systems, but to serve as a resource that can inform sourcing decisions while those frameworks continue to evolve. Reflecting the broader CDR market, we will continue to refine this guidance as new evidence, implementation experience, and stakeholder input strengthen understanding.

The primary audience for this guide includes CDR buyers and BiCRS project developers sourcing agricultural residues. It is intended to support contractual diligence, sourcing

decisions, and risk differentiation across feedstocks, regions, and suppliers. In doing so, the guide emphasizes that risk and uncertainty are not evenly distributed across sourcing contexts. Higher uncertainty or governance risk often necessitates more conservative documentation and oversight to achieve comparable confidence in outcomes. This approach is not intended to penalize lower-capacity regions, but to avoid the perception of false equivalence across fundamentally different sourcing conditions.

Agricultural residues span diverse regions, governance systems, and production contexts. The principles in this guide are broadly applicable, but their implementation will depend on local legal frameworks, institutional capacity, and project-specific conditions. Buyers and project developers are responsible for applying this guidance to local conditions, and negotiating parties must determine how it applies to specific geographies.

Areas for future work

Agricultural biomass sourcing for CDR is ever evolving. The following topics are several areas that warrant further research, refinement, and stakeholder engagement.

1. **Soil organic carbon (SOC) and residue removal:** Residue removal is likely to reduce SOC over time, but the magnitude of that reduction remains uncertain. Impacts are highly site-specific and practice-specific, varying with soil type, climate, tillage regime, rotation, and removal rate. The existing literature leaves gaps: most field studies focus on a narrow range of cropping systems and geographies, and data on modest removal rates across diverse agricultural contexts remain limited. Additional field research is needed to refine and improve SOC accounting criteria for residue-based CDR pathways.
2. **Residue ownership and customary use rights:** In many regions, residues may have informal or community-based uses that formal contracts or land tenure documentation do not fully capture. As residue markets develop, additional clarity around rights and benefit-sharing may be needed to mitigate unintended social impacts.
3. **Sustainable availability under realistic constraints:** High-level technical supply estimates often do not fully account for soil carbon needs, competing uses, or regional

governance limitations. Developing more nuanced assessments of sustainable availability remains an important priority.

4. **Monitoring, reporting, and verification (MRV):** Strengthening confidence in data quality and verification processes (particularly in context with higher uncertainty) will be essential as markets mature.

This guide reflects Carbon Direct's best judgment based on available evidence and market experience. It is expected to evolve as implementation experience accumulates and as scientific understanding and policy frameworks develop. Further feedback from buyers, developers, researchers, and affected stakeholders will be critical to refining and improving this guidance over time.

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Principles and criteria for sustainable agricultural biomass sourcing

Preamble

The agricultural biomass feedstock ("Biomass") sourcing requirements set forth below shall be applied by the seller ("Seller") in the generation of biomass-based carbon credits or similar services ("Credits") for sale to the buyer ("Buyer").

For the purposes of these requirements, **Biomass** shall be defined as:

- All agricultural-derived biomass residues or by-products used as feedstock in the production of Credits, including that which is already sourced for pre-existing, associated energy and non-energy products.

For the purposes of these requirements, the **Place(s) of Origin** shall be defined as either:

- **Field origin:** The farm, field, or land production unit where the Biomass is generated, whether sourced directly from farms or indirectly through aggregators, distributors, or other intermediaries.
  - Where multiple field origins share contiguous ecological and agronomic characteristics (e.g., dominant crop types, soil and climate conditions, management systems), they may be defined and assessed collectively as a single Place of Origin, delineated by a documented geographic boundary using relevant regional authorities or agricultural statistical zones.
- **Facility origin:** The processing facility at which Biomass is generated and first becomes available for use.
  - Where Buyer and Seller agree that upstream visibility is required for Biomass sourced through a processing facility, Seller shall also define a field origin representing the geographic area from which the facility draws its agricultural feedstock, and apply relevant criteria to that area.

For the purposes of these requirements, **Representative Sample** shall be defined as:

- A subset of sites within the Biomass Place(s) of Origin that may be used to demonstrate compliance with monitoring and reporting requirements in place of full coverage across all participating sites. The Representative Sample shall be designed and implemented according to a transparent, documented sampling plan that is demonstrated to be unbiased and derived from representative sampling methods, reflecting the diversity of Seller's supply base. It refers to a group of sites that: (1) captures the range of geographic, ecological, social, and management conditions present in Seller's Place(s) of Origin, including variations in soil type, climate, production system, labor arrangements, customary uses, tenure arrangements, and management intensity; (2) is of sufficient size to provide a statistically or scientifically-defensible level of confidence that monitored indicators reflect Seller's Place(s) of Origin performance within an acceptable margin of error; and (3) is selected using a consistent and repeatable method that allows for periodic re-evaluation or adjustment.

Evidentiary requirements

The requirements below **apply across all subsequent Principles and Criteria**, each subject to a risk-based assurance approach.

Governance risk shall inform the required level of evidence for demonstrating compliance, as determined using country-level indicators such as the Corruption Perceptions Index,[6] Worldwide Governance Indicators,[7] Land Governance Assessment Framework,[8] and Rule of Law Index,[9] together with project-level factors including supply-chain complexity, land-tenure transparency, and the number of intermediaries. Projects shall be assigned to one of three Assurance Tiers. The assigned Assurance Tier sets the minimum evidentiary standard wherever this guide requires Seller to **provide evidence or maintain records** for substantive requirements—that is, all requirements that affect eligibility or credited quantity. Across all Assurance Tiers, compliance may be demonstrated using a Representative Sample.

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6. The Corruption Perceptions Index is Transparency International's annual country score of perceived public-sector corruption.
7. Worldwide Governance Indicators are the World Bank's country indicators on governance, including rule of law and control of corruption.
8. The Land Governance Assessment Framework is the World Bank's diagnostic instrument to assess the state of land governance at the national or sub-national level.
9. The World Justice Project's Rule of Law Index provides annual country rankings on rule of law, including constraints on government powers and absence of corruption.

Assurance Tier 1 (Standard): Seller shall demonstrate compliance using routine business records and **supplier documentation.** Seller shall **review and update evidence upon any material change** in practices, Place(s) of Origin, supply-chain structure, or scale. Attestations may be used only where supported by independent corroborating evidence relevant to the claim.

Assurance Tier 2 (Enhanced): Seller shall corroborate compliance with substantive requirements using **independent data or documentation.**[10] In addition, substantive claims shall be subject to **risk-based testing** through trace-backs under a documented sampling plan. Seller shall **review and update evidence at least every three years** and upon any material change in practices, Place(s) of Origin, supply-chain structure, or scale. Attestations may support compliance but shall not be the primary evidence for any substantive requirement.

Assurance Tier 3 (High): In addition to Tier 2 requirements, **an independent third party,** such as an accredited verification body or equivalent, shall verify compliance with substantive requirements. Seller shall review and update evidence at least **every two years** and upon any material change in practices, Place(s) of Origin, supply-chain structure, or scale. Attestations are not sufficient for substantive requirements.

Where the language of a specific criterion implies a higher evidentiary standard than the assigned Assurance Tier would otherwise require, the criterion-level requirement governs. Buyer and Seller may also mutually agree to apply a higher or lower Assurance Tier to individual Criteria, provided the rationale is documented.

If Seller cannot reasonably demonstrate legality, transparency, and control over sourcing risks at the required Assurance Tier, the project shall not source Biomass from that Place(s) of Origin or supply network.

10. Independent corroboration may include sources such as, but not limited to, third-party data, public and government records, academic research, independent transaction evidence, accredited independent testing results, and other forms of data not generated by Seller.

Explanation

The Assurance Tier assigned to a project determines how rigorously Seller must document compliance with each substantive requirement in this guide. It does not determine whether a given sourcing practice is acceptable, but rather what kind of evidence is needed to demonstrate claims that it is. Assurance Tier selection is a structured professional judgment, not a mechanical scoring exercise. It begins with country-level governance indicators, which provide a baseline read on the institutional environment in which sourcing occurs. That baseline is then adjusted based on project-level factors: a simple, short supply chain with direct landowner relationships and clear tenure documentation may warrant a lower tier even in a country with moderate governance scores, while a complex, multi-intermediary chain with limited traceability may warrant a higher tier even in a strong-governance context. The key question is whether the institutional and commercial environment creates conditions under which claims could go unverified.

The three Assurance Tiers represent a continuum of evidentiary rigor. Assurance Tier 1 (Standard) is appropriate where governance and supply-chain conditions provide reasonable confidence that routine business records, (e.g., contracts, delivery receipts, supplier declarations) can substantiate claims, with independent corroboration available where needed. Assurance Tier 2 (Enhanced) applies where conditions call for more structured verification: auditable recordkeeping, documented sampling plans, and systematic spot-checks that go beyond what Seller's normal business processes would produce. Assurance Tier 3 (High) is reserved for contexts where governance risk or supply-chain opacity is significant enough that an independent third party must verify compliance. Illustrative examples of evidentiary requirements across Assurance Tiers are provided in "Appendix: Illustrative evidentiary requirements across Assurance Tiers".

Buyer and Seller should agree on the assigned Assurance Tier early and revisit the assignment if material changes occur in the supply chain, sourcing geography, or scale of operations. Where indicators point in different directions the parties should err toward the higher Assurance Tier unless specific, documentable factors justify a lower one. The goal is to calibrate documentation burden so that both parties can have warranted confidence in the claims being made.

Principle 1

Biomass must be traceable. Compliance with this principle is met through one criterion.

Criterion 1.1

Biomass must be traceable across the supply chain from the Place(s) of Origin to the point of conversion for CDR.

- **Option A:** Seller shall maintain segregation or identity-preserved, chain-of-custody system from origin to conversion that prevents commingling across different origins or sourcing classifications, preserves origin geolocation, and reconciles volumes (e.g., inputs, outputs, losses, inventory) at each supply node.
- **Option B:** Seller shall maintain a mass-balance, chain-of-custody system from origin to conversion, with transaction recording, node-level volume reconciliation, and origin geolocation retained at the applicable point of origin. Seller shall define balancing periods for each Biomass type and sourcing classification.
- **Option C:** Seller shall maintain an auditable traceability program that links Biomass to the applicable control point (e.g., farm, producer group, collection hub, or first processor, as relevant) and preserves that linkage to conversion, with transaction recording and volume reconciliation sufficient to support trace-back investigations.

Explanation

Traceability for Biomass can be challenging due to multi-actor, dynamic supply chains and commingling across collection, aggregation, processing, and transport. Chain-of-custody systems maintain oversight by preserving origin attribution and enabling reconciliation of physical volumes through the supply chain.

Option A provides the strongest integrity by using segregation or identity preservation to prevent commingling across origins or sourcing classifications while maintaining origin geolocation and node-level volume reconciliation.

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Explanation (continued)

Option B is often more scalable, using mass balance with transaction recording, node-level reconciliation, and retention of origin geolocation at the applicable point of origin within defined balancing periods.

Option C provides a baseline approach by linking Biomass to an applicable control point and preserving that linkage to conversion with auditable records and reconciliation sufficient to support trace-back investigations. However, it does not provide the same commingling protections as Option A or Option B.

Evidentiary requirement: Seller must demonstrate compliance with the selected chain-of-custody option through system design documentation and internal records (Assurance Tiers 1 and 2) or through independent third-party verification of the chain-of-custody system (Assurance Tier 3).

Principle 2

Biomass must come from sources with low risk of negative impacts on local communities, workers, vulnerable groups, and Indigenous Peoples. Compliance with this principle is met through five criteria.

Criterion 2.1

Biomass must be sourced from harvesting or processing operations that present low risk[11] of community health impacts and implement strategies for mitigating any health risks.

- **Option A:** Seller shall provide documentation demonstrating that Biomass harvesting, collection, handling, and processing present low risk of community health impacts relative to baseline conditions.[12] In addition, Seller shall maintain an accessible, culturally appropriate grievance mechanism that enables community members to raise concerns, with documented procedures for response and resolution.
- **Option B:** Where risks of community health impacts are present (e.g., adverse impacts to air or water quality, increased traffic or noise exposure, community complaints, or project opposition), Seller shall conduct and document a risk-based assessment, prior to sourcing, to evaluate potential community risks associated with Biomass harvesting, collection, storage, transport, and processing.[13, 14, 15, 16] Seller shall implement mitigation strategies proportionate to risks identified in the assessment, such that mitigated risks are low. In addition, Seller shall maintain an accessible, culturally appropriate grievance mechanism that enables community members to raise concerns, with documented procedures for response and resolution.

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11. Seller shall provide documentation detailing their risk assessment methodology. This documentation must clearly define Seller's criteria for "low risk" versus "high risk" for their specific biomass type.
12. Baseline conditions refers to the state of community health impacts (e.g., air quality, noise levels, traffic intensity, or water quality) prior to commencement of Biomass residue collection or processing activities, as documented at project initiation or through publicly available data.
13. The assessment shall involve, at minimum, consultation with local stakeholders (as defined by The Spectrum of Community Engagement to Ownership) and relevant community advocacy groups (e.g., Community Action Agencies, local NGOs) to ensure that community perspectives are adequately represented.
14. The Movement Strategy Center. 2021. The Spectrum of Community Engagement to Ownership, [accessed 2026 Mar 27]. https://movementstrategy.org/wp-content/uploads/2021/08/The-Spectrum-of-Community-Engagement-to-Ownership.pdf
15. The assessment must include, at a minimum, air quality risks (e.g., from harvesting or processing equipment), transportation and noise-exposure related risks, and water risks (e.g., leachate, increased chemical use due to Biomass removal).
16. At a minimum, the assessment must: (1) identify specific potential hazards (e.g., emissions, noise, traffic, water runoff), (2) identify the community populations potentially exposed, (3) evaluate the likelihood and severity of those impacts, and (4) define the specific mitigation strategies to be implemented.

Explanation

The use of agricultural residues may pose health risks to adjacent and nearby individuals and/or communities beyond normal agricultural operations. These risks can include, but are not limited to, dust and noise exposure from collection, transport, or processing, fire risk from stockpiled Biomass, and environmental hazards such as water contamination from runoff or leachate. While many agricultural zones already experience a baseline of traffic, dust, and noise, impacts become significant when Biomass activities introduce new concentration points (e.g., depots, stockpiles, or grinding operations), substantially increase truck traffic through communities, or occur in close proximity to sensitive locations like homes, schools, or clinics.

This criterion provides two pathways to safeguard community health. Option A is intended for contexts where residue collection and processing practices demonstrate low risk of community health impacts relative to existing agricultural conditions, and where documentation can show that sourcing does not materially increase community exposure and may even reduce community exposure (e.g., through reductions in in-field residue burning). Option B, by contrast, recognizes that a risk assessment is necessary where residues may pose elevated risks, as it provides an evaluation of potential impacts on air, water, and soil quality, as well as traffic and noise, and ensures that mitigation measures are developed to reduce risks to a low level.

Documentation under this criterion should reflect the nature of the sourcing context. For crop-based Biomass, evidence may include farm-level records describing harvesting methods, residue storage practices, transport logistics, equipment use, and safe handling of agricultural chemicals. For processing-based Biomass, documentation may include facility-level operating procedures for dust and noise control, emissions monitoring records, traffic management plans, and water sourcing and protection measures.

Criterion 2.2

Biomass must be sourced only from suppliers who hold lawful and legitimate rights[17] to access, collect, use, and transfer the Biomass, and in ways that respect statutory and customary land, resource, and access rights of Indigenous Peoples and local communities (including customary rights to collect and use residues).

For processing facilities

Where sourced Biomass is solely a by-product of agricultural processing operations, Seller is not required to verify farm- or landholder-level Biomass rights. Instead, Seller shall retain documentation demonstrating that the facility lawfully owns or controls the by-product and has the right to transfer it, and that the by-product is not pledged or otherwise allocated to another party or obligation.

For all other Biomass suppliers

- **Option A:** Seller shall furnish legal documentation or other authoritative records of lawful and legitimate rights to: (1) use or access the land for the primary crop, and (2) own or control and transfer all Biomass. Seller shall demonstrate that Biomass transfer does not infringe on statutory or customary rights, including Indigenous Peoples' and local communities' rights of access and use. Where Indigenous Peoples use or occupy sourcing lands, Seller is explicitly required to conduct free, prior and informed consent (FPIC)[18] processes. Acceptable documentation may include, as applicable, contracts, leases, farm-management agreements, crop receipts, cooperative or producer records, consent letters from the relevant rights-holding community, or signed attestations from the party transferring the Biomass. Where overlapping or shared rights may exist, Seller shall provide documented evidence of consultation and confirmation of no objection from affected rights-holders prior to residue collection.
- **Option B:** Seller shall conduct and document a desk-based risk assessment for Place(s) of Origin and associated supply chain(s) to determine whether Biomass rights are likely to be clear and uncontested. The risk assessment shall, at minimum:

17. Lawful rights refers to rights to use and access Biomass in ways that are recognized under formal law. Legitimate rights encompasses documented and undocumented rights that hold social legitimacy and/or exist under customary law, ensuring customary and traditional land-use arrangements are respected on equal footing with formal legal titles.

18. Minimum FPIC elements: identification of representative institutions, provision of adequate time and information for community decision-making, documentation of the process and outcome, and a mechanism for communities to withhold or withdraw consent.

- Conduct and document targeted consultation with local civil society organizations or legal practitioners with relevant experience in local customary and statutory land and resource rights in the Place(s) of Origin;
- Identify and analyze the local statutory and customary law, land and resource tenure systems, and Biomass-rights holding arrangements;
- Identify areas of plausible overlapping, competing, or contested Biomass claims;
- Map and assess credible indicators of unclear or disputed rights, using documenting sources and, where necessary, additional local stakeholder input;
- Evaluate credible indicators of disputes or conflict related to tenure or rights; and
- Determine whether additional engagement, validation, or consent processes are required to establish legitimacy of rights. Where Indigenous Peoples use or occupy sourcing lands, Seller is explicitly required to conduct FPIC processes prior to engagement.

If the assessment is in any way inconclusive or indicates elevated risk, Seller shall escalate to local validation and site-level verification sufficient to confirm authorization and consent consistent with applicable law and locally governing arrangements. Where escalation does not support a low-risk conclusion, Seller shall exclude the Place(s) of Origin.

Explanation

Biomass sourcing can create risks related to Biomass rights and land tenure, particularly in contexts where records are incomplete, customary rights are prevalent, or power imbalances enable intermediaries to profit without the consent of rightful owners. Such risks may include disputes over ownership or control of residues, or failure to recognize Indigenous or community-held land tenure rights.

This criterion therefore requires Seller to confirm that the party transferring Biomass has the legal authority to do so and that Biomass collection does not infringe on statutory or customary rights. The criterion provides two pathways. Option A relies on direct documentation of land use and Biomass rights, and confirmation that both statutory and customary rights are respected and undisputed. Option B recognizes that parcel-level or representative documentation may not always be feasible across large or complex supply networks. In such cases, Seller is required to conduct a risk-based assessment. Where risks of unclear or contested rights are identified or where evidence is inconclusive, Seller must escalate to local validation or site-level verification.

Criterion 2.3

Biomass must be sourced from agricultural operations that ensure the economic, social, and physical well-being of workers, including through fair compensation, respect for labor rights, and mitigation of health risks.

Seller shall conduct a risk-based assessment across its Biomass supply chain, beginning at the Place(s) of Origin. The assessment shall evaluate the risks of violating the fundamental Conventions set forth by the International Labour Organization (ILO) in the *ILO Declaration on Fundamental Principles and Rights at Work and its Follow-Up*.[19, 20] Sellers must implement and demonstrate risk mitigation measures (e.g., through process changes, engineering controls, provision of personal protective equipment, and emergency stations) and any additional due diligence appropriate to the degree of risk.

Explanation

Agricultural Biomass supply chains often involve a mix of labor arrangements, including direct employment, contracted services, seasonal labor, and informal work. Depending on the operating context, workers may face risks such as unsafe working conditions, excessive hours, inadequate compensation, and limited access to grievance mechanisms. In some contexts, risks of child labor, forced labor, or exploitation may arise.

This criterion requires Sellers to actively assess these risks across their Biomass supply chains and ensure alignment with internationally recognized labor standards, as defined by the ILO Declaration on Fundamental Principles and Rights at Work. The expectation is not only an assessment of compliance, but identification and mitigation of elevated risks. Where risks are material, mitigation and corrective actions should demonstrate that worker well-being is protected.

19. International Labour Organization. 2022. ILO Declaration on Fundamental Principles and Rights at Work and its Follow-Up, Section 2, page 9. [accessed 2026 Mar 27]. https://www.ilo.org/sites/default/files/2024-04/ILO_1998_Declaration_EN.pdf
20. International Labour Organization. 2026. Conventions, Protocols and Recommendations. [accessed 2026 Mar 26]. https://www.ilo.org/international-labour-standards/conventions-protocols-and-recommendations

Criterion 2.4

Biomass must be sourced from operations that both recognize customary uses[21] of Biomass (e.g., animal fodder, bedding, fuel) and present a low risk of negative social, environmental,[22] and economic impacts from diverting Biomass from customary uses, such that sustained customary use remains possible.

- **Option A:** Seller shall provide unambiguous evidence demonstrating that Biomass sourcing does not displace customary uses.
- **Option B:** Where customary uses of Biomass are present, Seller shall ensure that customary use needs continue to be met. Seller must provide evidence that either:
  - Sufficient Biomass remains available to meet customary needs; or
  - Where sufficient Biomass is not available, substitutes of comparable quality and affordability are accessible to the affected users, either through market supply or Seller's direct provision, and these substitutes have no additional social and environmental risks.

Explanation

Agricultural residues often have alternative uses that carry an economic, social, and cultural value for both farmers and communities. These include livestock fodder, bedding, household fuels, composting, mulching, construction materials, or shared community uses. Diverting residues into Biomass supply chains without accounting for these customary uses can create negative impacts for farmers and communities, such as increased costs for feed or fuel or reduced Biomass availability.

Option A is available only in limited circumstances where the absence of customary use is unambiguous. Most projects will select Option B, which applies where customary uses are present or affected. In such cases, Sellers must actively ensure that community needs continue to be met, either by ensuring sufficient Biomass availability, comparing access to suitable substitutes that do not introduce new risks, or sourcing Biomass elsewhere. In assessing customary uses, Sellers should ensure that affected users include not only titled landholders but also women, landless

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21. Customary use refers to established practices where households or communities beyond the agriculture field collect or use Biomass.
22. Environmental considerations related to customary practices of leaving Biomass on the field are addressed under "Principle 3".

Explanation (continued)

households, and other community members who rely on residues for household energy, fodder, or livelihood needs. The intent of this criterion is not to prohibit Biomass sourcing where customary uses exist, but to prevent social harm by ensuring Biomass diversion does not undermine existing livelihoods. This criterion adds an outcome-based safeguard, recognizing that customary users may not always be the same as legal or customary rights holders and that livelihoods can be affected even where procedural requirements, as outlined in Criterion 2.2 and 2.5, are satisfied.

To support either pathway, Seller may conduct a market assessment that evaluates Biomass supply and demand in the sourcing region, identifies likely substitutes for displaced Biomass, and assesses the associated environmental and social impacts. If the assessment indicates that the most likely replacement materials or practices would result in net environmental or social harm, the project should not proceed.

Criterion 2.5

Biomass rights-holders must agree to the value assigned to their residues, whether that value is monetary or non-monetary.

Seller shall document that Biomass rights-holders were informed of, and voluntarily accepted, the value exchange for Biomass, whether monetary or non-monetary, with the ability to decline. Evidence must be sufficient to demonstrate transparency, equitability, and consistency with local practices and customs. Acceptable forms of evidence include, but are not limited to, signed contracts, cooperative agreements, avoided cost documentation, community benefit agreements, or other mechanisms consistent with local practices.

Explanation

This criterion ensures that the exchange of value for Biomass is transparent, fair, and accepted by the owner who has rights to transfer the Biomass. Value of Biomass may take on several forms, including monetary payment (e.g., direct payment per unit of residue or revenue-sharing arrangements), or non-monetary value (e.g., service provision, avoided costs, or in-kind benefits). In all cases, Seller shall ensure rights-holders understand and agree that the value offered reflects equitable treatment. In all cases, Seller shall ensure that rights-holders understand, agree to, and verify that the value offered is equitable relative to local market conditions or customary arrangements, and shall disclose that the intended use of residues is for CDR credit generation. The intent of this criterion is to ensure that Biomass removal is not extractive, coercive, or based on unclear expectations.

Principle 3

Biomass must be sourced and managed in ways that minimize negative impacts on soil, including soil health, quality, and carbon stocks, and do not threaten protected areas. Compliance with this principle is met through four criteria.

Criterion 3.1

Biomass must be sourced in ways that maintain or account for SOC stocks over time.

- **Option A:** If Biomass procured would not otherwise have been retained on the field or returned to the field, then Seller is considered compliant with this criterion. For field residues, Seller must demonstrate this based on residue management in the three years immediately preceding Seller's initiation of procurement or engagement with the producer. Corroborating evidence may include:
  - Farm-level biomass or soil management plans and dated historical records;
  - Farmer, landowner, producer, or facility attestations;
  - Government datasets at state- or provincial-level resolution (or finer);
  - Remote-sensing outputs showing post-harvest residue cover or indices with stated methodology; or
  - Dated geo-tagged field photographs verifying historical removal or non-retention.
- **Option B:** If Biomass is procured from field residues that would otherwise have been retained on or returned to the field, Seller shall apply a SOC deduction to the project's calculation of net CDR, and shall demonstrate that the residue Take Rate does not exceed a conservative threshold. Take Rate is defined as the mass fraction of all aboveground crop residue removed from the field during the crop cycle in which removal occurs, measured on a dry-weight basis and applied uniformly across each field.[23]
  In dry cropping systems, Seller shall apply a default Take Rate of no more than 30% and a conservative SOC deduction as a percent of the carbon content of all additional

23. Take Rate is inclusive of residues removed for all purposes (not limited to Biomass used in the generation of Credits) and is measured at the individual field level.

removed Biomass.[24] Seller may propose alternative SOC deduction values at any Take Rate if supported by peer-reviewed, field-validated evidence specific to the sourcing region's soil type, climate, and management regime.

Explanation

Removal of agricultural residues from fields reduces SOC. This finding is directionally consistent across hundreds of long-term field experiments and global meta-analyses. These studies support a 30% Take Rate as a conservative threshold in dry cropping systems, at which counterfactual SOC impacts are reduced.[25] However, the magnitude of loss is meaningful in the context of CDR claims. Meta-analyses estimate that, for complete aboveground residue removal, approximately 25% of residue carbon retained in the field is stabilized as SOC over the first decade following a change in residue retention, implying a corresponding reduction in net CDR for projects that divert field residues.[26] Because the response to residue removal is non-linear, and the marginal efficiency at low Take Rates is lower than the whole-range average, a 13–29% default deduction for a 30% Take Rate is defensible and derives from data collated by Xu et al. (2019) and Alvarez (2024). The evidence base at low Take Rates is thin, and the deduction should be revisited as longer-term, multi-rate field data become available. Local field-validated evidence may support alternative values for both Take Rate and SOC deduction.

Option A applies where residues were not historically applied on the field such that no SOC impact is attributable to the project. This includes processing residues generated at a facility, as well as field residues that were routinely burned, removed, or otherwise not returned to the soil prior to the project's initiation. Option B applies where field residues that would otherwise have been retained are diverted for use as Biomass feedstock.

24. Limited empirical literature suggests that the SOC deduction for dryland systems may fall in the range of 13–29%. This means that 13–29% of the carbon content of Biomass may not be counted toward net CDR production. Seller and Buyer will mutually agree on the SOC deduction to be applied. Practically, processes with low conversion efficiency will have credit deductions that are larger than 15%. Deduction shall not apply to residues previously removed from the field for other purposes (i.e., non-Biomass) and diverted for use by the project.
25. Xu H et al. 2019. A global meta-analysis of soil organic carbon response to corn stover removal. GCB Bioenergy. 11(10):1215–1233 [accessed 2026 Mar 17]. https://doi.org/10.1111/gcbb.12631
26. Alvarez R. 2024. A quantitative review of the effects of residue removing on soil organic carbon in croplands. Soil and Tillage Research. 240:106098 [accessed 2026 Mar 17]. https://doi.org/10.1016/j.still.2024.106098

Criterion 3.2

Biomass must be sourced in ways that maintain or enhance ecological function including nutrient cycling, soil health, and hydrologic regulation.

- **Option A: See "Criterion 3.1", Option A.**
- **Option B:** If Biomass is procured from field residues that would otherwise have been retained on or returned to the field, Seller shall ensure that residual biomass cover prevents erosion and compaction (using locally recommended benchmarks and accounting for slope, soil, and precipitation). Seller moreover shall directly quantify and document the condition of soil health and ecological function to demonstrate that Biomass sourcing has not caused soil degradation. Documentation may be based on periodic soil-health measurement, field observation, or model-supported assessment following recognized guidance such as from the Soil Health Institute[27] or national extension frameworks. Indicators shall address the physical, chemical, and biological dimensions of soil function (e.g., structure, infiltration, organic matter, and biological activity).

Explanation

Just as it can affect SOC, taking residues off fields can degrade soil health. When retained or incorporated into the field, agricultural residues contribute to a myriad of soil benefits such as nutrient cycling, soil organic matter, reduced soil erosion, and water regulation. Excess removal of crop residues can compromise these benefits, potentially reducing soil fertility, moisture retention, and long-term productivity. Because soil health responses vary widely by local context, baseline conditions may be best interpreted using local agronomic guidance. This criterion ensures that residues previously retained in-field are not newly removed for sourcing, thereby protecting soil health.

Option A applies where residues were not historically applied on the field such that no soil health impacts are attributable to the project. This includes processing residues generated at a facility, as well as field residues that were routinely burned, removed, or otherwise not returned to the soil prior to the project's initiation. Option B applies where field residues that would otherwise have been retained are diverted for use as Biomass feedstock.

27. Soil Health Institute. 2026. Recommended Measurements for Scaling Soil Health Assessment. [accessed 2026 Mar 27]. https://soilhealthinstitute.org/our-work/initiatives/measurements/

Criterion 3.3

Biomass must not come from Place(s) of Origin where production expands into or causes harm to any area that is legally protected, ecologically sensitive, culturally significant, or designated for non-agricultural use.

Seller shall provide evidence demonstrating that the Places(s) of Origin, and an appropriate buffer (e.g., 1 kilometer), neither overlap with nor will harm any protected or conserved areas. Evidence to prove this must include, at a minimum, all of the following:

1. Site boundary files and overlays showing no intersection with layers for protected areas and other effective area-based conservation measures such as World Database on Protected Areas,[28] Ramsar sites,[29] Key Biodiversity Areas,[30] and High Conservation Value[31] areas
2. Documentation indicating identification of any Indigenous or community managed conserved areas (e.g., via LandMark[32] or equivalent), with evidenced confirmation that locally agreed upon rules are respected
3. Documentation (including source and release date) of all datasets used in (1) and (2)

In specific exceptional situations, Biomass may be removed from ecologically sensitive or adjacent areas if it serves widely recognized ecological reasons, or if it is part of a documented conservation plan endorsed by a land management authority.

Explanation

This criterion establishes restricted areas for Biomass sourcing. It ensures that project activities do not occur within, expand into, or adversely affect legally protected, ecologically sensitive, culturally significant, or non-agricultural areas. The purpose of this criterion is to avoid direct damage to high-value places and to prevent biodiversity loss, carbon stock losses, ecosystem degradation, and harm to Indigenous Peoples or local communities.

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28. Protected Planet. 2026 World Database on Protected Areas. [accessed 2026 Mar 27]. https://www.protectedplanet.net/
29. Ramsar. 2026. List of Ramsar sites. [accessed 2026 Mar 27]. https://rsis.ramsar.org/
30. Key Biodiversity Areas. 2026. Map Search. [accessed 2026 Mar 27]. https://www.keybiodiversityareas.org/map
31. HCV Resource Network. 2017. Common Guidance for the Identification of High Conservation Values. [accessed 2026 Mar 27]. https://cdn.prod.website-files.com/624493bb51507d22cf218d50/6286878c1de2255dee34ecfc_HCVCommonGuide_English-07-17-web.pdf
32. LandMark. 2025. Global Map. [accessed 2026 Mar 27]. https://landmarkmap.org/

Criterion 3.4

Biomass must not be sourced from land that has been converted from a natural ecosystem to agriculture within the past 20 years.

Seller shall document evidence of adherence with this criterion for each Place of Origin, such as through remote sensing analysis or historical land use records. Documentation must show one of the following:

- No conversion from natural ecosystems[33] to agriculture within the past 20 years.
  - Land that was previously under agricultural production and has since been retired, fallowed, or otherwise left idle does not constitute as a natural ecosystem, provided that: (1) the land is still formally classified as agricultural land under the applicable national or subnational land-use framework; and (2) the land is not undergoing significant ecological succession toward its prior natural state (e.g., establishment of native woody vegetation, measurable increases in carbon stocks, or return of native species assemblages).
- Conversion did occur between years 5 and 20 years *prior* to the proposed project start date, but meets all of the following conditions:
  - The land was previously degraded, and prior to its conversion exhibited reduced productivity, soil erosion, loss of native vegetation, diminished habitat value, or other measurable signs of ecological decline compared to locally recognized thresholds.
  - The agricultural conversion verifiably improved environmental (e.g., soil restoration, erosion control) and social conditions relative to the prior degraded state.
  - The conversion did not replace native ecosystems (including wetlands, peatlands, forests, grasslands, or other native habitats), nor areas of high conservation value, high biodiversity importance, or high ecological productivity.
  - The conversion process was transparent and legally sanctioned.

33. Where idle agricultural land is undergoing significant ecological succession, it shall be treated as a natural ecosystem for the purposes of this criterion.

Explanation

This criterion prevents Biomass sourcing from contributing to recent agricultural expansion into natural ecosystems. Conversion includes clearing, burning, or other actions that replace native vegetation or alter natural hydrology to enable agricultural use, including infrastructure such as access roads or storage areas. However, limited exceptions may apply where legal conversion has occurred on degraded land and where agricultural conversion has demonstrably improved environmental and social conditions relative to the prior state.

Principle 4

Biomass must come from sources that do not distort markets for agriculture or forestry products. Compliance with this principle is met through two criteria.

Criterion 4.1

Biomass sourcing must not incentivize agricultural expansion or intensification.

Seller shall provide documentation demonstrating that Biomass is an agricultural by-product, providing no more than 10% of total economic value of crop materials (including value from both primary products and by-products). The percentage shall be calculated as the net economic value of Biomass supplied to the project (i.e., market value less collection, handling, and transport costs borne by the producer) divided by the total economic value of all crop outputs from the same production system, where prices reflect true market value. Where primary crop data is unavailable or has been deemed commercially sensitive by the producer, it is acceptable to use credible regional market data as a replacement.

Explanation

This criterion addresses the risk that growing Biomass demand could influence agricultural production decisions in ways that could undermine environmental integrity or market stability. If residues become a significant revenue driver, producers may be incentivized to expand cultivated areas, alter cropping patterns, or intensify input use to increase residue output. Seller must demonstrate that residue sourcing remains economically and operationally ancillary to the primary crop system to be in compliance with this criterion. The 10% threshold is informed by observations across agricultural systems, where residues typically have little to no economic value or represent only a small share of total crop value.

Criterion 4.2

Pursuant of accurate carbon accounting, biomass sourcing must assess both the counterfactual fate of biomass and potential diversion of residues from existing uses.

Seller shall:

- Identify and justify the counterfactual fate of the biomass, defining a baseline scenario that reflects the carbon storage that would have occurred in absence of the project;
- Identify the existing, economical uses of each Biomass type, and evaluate whether diverting residues from existing commercial or industrial uses (e.g., energy production) will induce substitution, price increases, changes in regional supply, or other market-mediated responses; and
- Generate the necessary data to determine any resulting changes in carbon emissions due to leakage impacts, as applicable.

Where relevant and applicable, Seller may leverage existing market assessments such as those conducted under "Criterion 2.4" to inform this analysis.

Explanation

Biomass residues have a counterfactual fate, such as decomposition, in-field retention, combustion for energy, or use in materials, and that fate determines how much carbon would have been stored or emitted in the absence of the project. In addition, Biomass residues often have existing economic market uses and their diversion can shift supply-and-demand dynamics and lead to substitution with higher-emissions alternatives.

Appendix: Illustrative evidentiary requirements across Assurance Tiers

Criterion and option	Assurance Tier 1 (Standard)	Assurance Tier 2 (Enhanced)[34]	Assurance Tier 3 (High)
Criterion 2.2, Option A	• Supplier documentation (e.g., contracts, leases, farm-management agreements, crop receipts, or cooperative records) demonstrating rights to access and transfer biomass • Attestation of no conflicting statutory or customary claims • Documentation of FPIC where applicable	• Assurance Tier 1 evidence plus corroboration through external sources (e.g., cross-referencing against public land registries, governance studies, and government data) • Documentation of independent expert consultation with local stakeholders to identify overlapping or contested rights	• An independent third party verifies Assurance Tier 2 evidence
Criterion 2.2, Option B	• Seller conducts and documents a desk-based risk assessment covering the requirements outlined in the criterion	• The desk-based risk assessment from Assurance Tier 1 is corroborated by independent data (e.g., published land governance assessments, published tenure research, or independent legal opinions specific to the Place(s) of Origin)	• An independent third party verifies Assurance Tier 2 evidence
Criterion 2.4, Option A	• Supplier attestation or records demonstrating absence of customary uses (e.g., clear business or farm records of biomass combustion on site, disposal records)	• Assurance Tier 1 evidence plus claims corroborated by independent sources (e.g., independent community-level consultations documented in writing or government reports specifying common practice)	• An independent third party verifies Assurance Tier 2 evidence

continued →

34. Trace-back tests and a documented sampling plan is also a requirement of this Assurance Tier.

Criterion and option	Assurance Tier 1 (Standard)	Assurance Tier 2 (Enhanced)[35]	Assurance Tier 3 (High)
Criterion 2.4, Option B	• Attestations or records identifying customary uses of Biomass (e.g., through market data, supplier data, cooperative records), along with evidence that one of the following is met: (1) sufficient Biomass remains (e.g., residue yield estimates compared to local demand), (2) substitutes are available, or (3) Biomass is sourced alternatively	• Assurance Tier 1 evidence plus claims corroborated by independent sources (e.g., structured stakeholder consultation with affected users, independent quantification of biomass availability, published market reports, government commodity data)	• An independent third party verifies Assurance Tier 2 evidence
Criterion 2.5, Evidence	• Biomass contracts, signed purchase agreements, transaction records, or community benefit agreements showing the agreed value for biomass • Supplier attestation that rights-holders were informed of terms and voluntarily accepted them with the ability to decline	• Assurance Tier 1 evidence plus transaction terms are corroborated (e.g., comparison of agreed prices against published regional market benchmarks, review of cooperative payout documentation, or independent surveys of prevailing local rates)	• An independent third party verifies Assurance Tier 2 evidence
Criterion 3.1, Option A	• Routine farm-level records of residue removal or combustion, such as biomass or soil management plans and dated historical equipment use or harvest log records	• Assurance Tier 1 evidence plus claims are corroborated by independent data (e.g., dated satellite-based residue cover or burn indices, government agricultural survey data, regional agronomic studies, or independent agronomic assessments)	• An independent third party verifies Assurance Tier 2 evidence

continued →

35. Trace-back tests and a documented sampling plan is also a requirement of this Assurance Tier.

Criterion and option	Assurance Tier 1 (Standard)	Assurance Tier 2 (Enhanced)[36]	Assurance Tier 3 (High)
Criterion 3.1, Option B	• Supplier documentation demonstrating harvest and removal volume records to calculate Take Rates (e.g., harvest logs, yield estimates, removal records) • Alternative SOC deduction values are based on field-validated data that represent the specific sourcing conditions	• Assurance Tier 1 evidence corroborated by independent sources (e.g., yield monitoring systems, cooperative aggregation records) • Alternative SOC deduction and Take Rate values are independently corroborated using published literature or field-validated data confirming applicability of the cited literature to the specific sourcing conditions	• An independent third party verifies Assurance Tier 2 evidence

36. Trace-back tests and a documented sampling plan is also a requirement of this Assurance Tier.

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