PM.0006

Use of waste recovery to transition to a circular economy

GHG Methodology
Version 1.0

Date of issue:	March, 2026
Status:	Final
Type:	New methodology
Developer:	Proba World BV
Contact:	methodologies@proba.earth

Table of contents

List of definitions

Additionality	Refers to the concept that any GHG project should result in greenhouse gas emissions mitigation (GHG reductions or removals) that would not have occurred without the project. In other words, the project's positive impact on reducing or removing emissions should be "additional" to what would have happened under the baseline scenario.
Baseline scenario	The baseline scenario represents the greenhouse gas emissions that would occur in the absence of the project intervention. It reflects the most likely set of activities, technologies, and practices that would continue under business-as-usual conditions, without the implementation of the proposed project.
Buffer pool	A buffer pool is a shared reserve of carbon credits established to cover potential losses in GHG Projects, ensuring the integrity of emission reductions or removals over time. Each GHG Project contributes to Proba's buffer pool when carbon credits are being issued. These carbon credits can only be used by Proba to compensate for reversals.
Carbon credit (emission reduction certificate)	A carbon credit represents at least 1 tonne of CO_2 (tCO_2), or 1 tonne of CO_2e (tCO_2e) reduced or removed for a certain period of time. One tonne (metric ton) (t) equals 1000 kg. For carbon equivalency, Proba uses the AR-6 assessment from UNFCCC[1] (see Appendix B: CO_2e and Global Warming Potential).
Carbon dioxide equivalent - CO_2e	A metric used to compare the emissions of various greenhouse gases based on their Global Warming Potential (see GWP definition). It expresses the impact of different gases in terms of the equivalent amount of CO_2, facilitating a standardized approach to assessing overall greenhouse gas emissions.
Conservativeness	When there is uncertainty or a choice between two or more assumptions, values, methodologies, or procedures, the option that is more likely to result in lower estimates of GHG emission reductions or removals must be selected. This approach ensures that claimed climate benefits are not overestimated.
Cradle-to-gate	A life cycle assessment boundary that includes all greenhouse gas emissions associated with a product's life cycle stages up to the point it reaches the project's location. This includes emissions from raw material extraction, production, and transportation to the project's location. It excludes emissions from field application or any subsequent stages beyond the project's location.

[1] https://ghgprotocol.org/sites/default/files/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_0.pdf

Crediting period	The "crediting period" refers to the specific duration of time during which a GHG project is eligible to generate and issue emission reduction certificates for the GHG emissions it reduces or removes. This period is predefined and ensures that the project's emissions impact is monitored, verified, and credited only within that set timeframe. A crediting period can be renewed once or multiple times.
Emission factors	Emission factors are coefficients that quantify the amount of greenhouse gases released into the atmosphere per unit of activity, substance, or process. They are essential tools in calculating emissions and facilitating the estimation of a project's total greenhouse gas emissions. The Intergovernmental Panel on Climate Change (IPCC) has established a three-tier system for the development and application of emission factors (Tier 1, Tier 2, and Tier 3). These tiers are presented in Appendix A: Data selection.
External waste	Waste materials originating from a different supply chain and recovered for use in producing another product (e.g., waste from one industry that is recovered and used as an input in a different manufacturing process).
Functional unit	Quantified performance of a product system used as the reference basis for all calculations and comparisons (e.g., "1 m^2 of packaging delivering X barrier performance for Y months"). Ensures that baseline and project are compared on an equivalent, function-based basis.
GHG project	Activity or activities that alter the conditions of a GHG Baseline and which cause GHG emissions reductions or GHG removals. The intent of a GHG project is to convert the GHG impact into emission reduction certificates.
Global Warming Potential (GWP)	The time-integrated radiative forcing resulting from a pulse emission of a specific greenhouse gas, relative to the radiative forcing from a pulse emission of an equivalent mass of carbon dioxide (CO_2). It provides a common scale to compare the climate impact of different gases over a specific time horizon, typically 100 years.
Insetting	Insetting refers to the practice of implementing sustainability interventions within a company's own value chain to reduce greenhouse gas (GHG) emissions or enhance carbon sequestration. Unlike offsetting, which typically involves purchasing carbon credits for activities outside the value chain, insetting focuses on reducing emissions directly linked to the company's operations, suppliers, or production processes.
Internal waste	Waste materials generated and recovered within the same

	supply chain. These materials are reintegrated into the production of the same product (e.g., scrap or by-products from a facility that are cycled back into the same production line).
IPCC	The Intergovernmental Panel on Climate Change is a United Nations body, assessing science related to climate change to provide policymakers with regular scientific updates.
Leakage	In the context of a GHG project, leakage refers to the unintended increase in greenhouse gas emissions outside the project boundaries as a direct result of the project's activities.
Offsetting	Offsetting refers to the practice of compensating for greenhouse gas (GHG) emissions by supporting projects outside a company's value chain that reduce or remove emissions. This is typically achieved by purchasing carbon credits from verified initiatives.
Overproduction	Overproduction refers to the intentional or avoidable manufacture of new, unused products in quantities exceeding actual demand or operational need, where such products are subsequently not placed on the intended market and instead diverted for treatment, recycling, or disposal. These products do not qualify as 'waste' under this methodology, as they have not arisen from genuine end-of-life discard, consumption, or process residue, but from surplus production. Any attempt to include such overproduced products as eligible waste streams shall be considered ineligible.
Post-consumer waste	Products that have reached the end of their useful life and are ready for final disposal (e.g., landfill, incineration) or recovery and recycling into new manufacturing processes.
Post-production waste	By-products or residual materials generated during the manufacturing process that are not part of the intended final product (e.g., trimmings, offcuts, process residues).
Proba Standard	The Proba Standard aims at controlling and reducing the risks related to GHG projects, their climate impact (emission reduction) and the corresponding issuance of emission reduction certificates and subsequent claims. It does so by relying on and aligning with internationally recognized standards frameworks and initiatives such as the Core Carbon Principles by the ICVCM and the ICROA Code of Best Practice. The Proba Standard sets out detailed procedures for identification and validation of GHG projects, and verification of emission reductions and removals, based on ISO 14064-2 . More information about the Proba Standard can be found at https://proba.earth/document-library.

Product Carbon Footprint (PCF)	The Product Carbon Footprint (PCF) is the sum of greenhouse gas (GHG) emissions and removals associated with a product's life cycle, expressed as CO_2-equivalents. It is based on the principles of life cycle assessment (ISO 14040/14044) and covers all or part of a product's life cycle (e.g., cradle-to-gate or cradle-to-grave), with clear system boundaries and assumptions. The PCF does not include offsets, and it requires transparent reporting of data, methods, and uncertainties to ensure consistency and comparability. Based on ISO 14067:2018, it is defined as the sum of GHG emissions and GHG removals in a product system, expressed as CO_2 equivalents and based on a life cycle assessment using the single impact category of climate change.
Project boundaries	The project boundaries of a GHG project delineate the spatial, temporal, and operational limits within which the GHG emissions, reductions, and removals are quantified and monitored, encompassing specific activities, sources, sinks, and reservoirs related to the project.
Project Overview Document (POD)	A document that offers a detailed summary of a GHG project's key elements, including governance, emission calculations, risk management, methodologies, and monitoring processes (see Proba Standard).
Recycling	Processing waste materials to obtain recovered resources for use in new processes or products, excluding energy recovery. Recycling covers activities such as collection, sorting, cleaning, and re-processing, but does not include reuse.
Refurbish	Restoring an item, during its expected service life, to a useful condition for the same purpose with at least similar quality and performance characteristics. Refurbishing may involve repair, rework, or updating components, but does not extend beyond the product's original service life.
Remanufacture	Returning an item to a like-new condition from both a quality and performance perspective, using an industrial process. Unlike refurbishing, remanufacturing can apply even after the expected service life of the product.
Repair	Restoring a product to a condition that allows it to function according to its intended purpose. This can include renewal or replacement of worn, damaged, or degraded parts.
Repurpose	Adapting a product or its components for use in a different function than originally intended, without major modification to its physical, chemical, or mechanical structure.
Reuse	Using a product or its components again, after their initial use,

	for the same purpose for which they were originally designed. Minor treatment (e.g. cleaning) may be needed.
System boundary	The set of criteria that specifies which unit processes are included in the product system for the study (e.g., raw material supply, recovery, manufacturing, transport, use, end-of-life), consistent with the project's scope. It must be defined so that compared systems use the same functional unit and equivalent methodological assumptions.
Tier 1, 2 and 3	In the context of greenhouse gas (GHG) emissions reporting and inventory management, data and methodologies are categorized into three tiers (Tier 1, Tier 2, and Tier 3), as defined by the Intergovernmental Panel on Climate Change (IPCC). These tiers represent varying levels of accuracy, data specificity, and complexity. For more information see Appendix A: Data selection.
Upcycling	Processing waste materials into new products of higher quality or environmental value than the original material or product. Unlike conventional recycling, which typically restores material to a similar or lower quality, upcycling increases the functional or aesthetic value of the output.
Verification and Validation Bodies (VVBs)	Third-party assurance entities, preferably ISO-accredited, are responsible for verifying that a project's activities and claims of emissions reductions and/or removals are conducted in accordance with established standards and methodologies, ensuring their accuracy and credibility.
Waste recovery	Waste recovery is defined as the use of wastes as an input material to create valuable products as new outputs. The aim is to reduce the amount of waste generated.

List of abbreviations

AR-6	IPCC Sixth Assessment Report
EF	Emission Factor
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
LCA	Life Cycle Assessment
LDC	Least Developed Countries
MRV	Monitoring, Reporting, and Verification
PCF	Product Carbon Footprint
POD	Project Overview Document
SDG	Sustainable Development Goal
SIDS	Small Island Developing States
VVB	Verification and Validation Body

1 Introduction

1.1 Background

The disposal of waste through landfilling, open burning, and incineration remains a major environmental and climate issue. According to the IPCC, methane emissions from solid waste disposal sites are the largest source of greenhouse gases in the waste sector, while incineration and open burning of fossil-based waste, such as plastics, are the primary sources of carbon dioxide (IPCC, 2006). These end-of-life practices not only lead to the significant release of greenhouse gases but also result in the permanent loss of materials that could otherwise be recovered. At the same time, the continued extraction and processing of virgin raw materials to meet industrial demand contributes significantly to global emissions and resource depletion. Recovering waste into usable products plays a critical role in reducing net greenhouse gas emissions. It allows for the avoidance of emissions from conventional disposal routes while also displacing the need for emissions-intensive virgin materials. By extending the life of materials following 9 circular economy 'R' strategies or principles, waste recovery directly supports the transition to a circular economy (EU Commission, 2020).

Effective climate impact, however, depends on more than just recovering waste. It requires systems that ensure the recovered output is of sufficient quality to replace virgin equivalents, is traceable through the value chain, and does not cause unintended consequences such as leakage. Effective sorting, processing, and documentation are necessary to maintain the integrity of such interventions.

Even though this methodology does not prioritize interventions targeting specific waste streams, it is important to acknowledge that different waste types can come with different GHG mitigation potential. For instance, a study did a system-wide LCA + LCC of all EU27 waste streams which ranked where savings come from and which streams offer the biggest improvement potential (Sund, 2025). In the study, the researchers found that for collected waste, plastic, mixed waste, sludge, hazardous waste, non-hazardous chemicals, biowaste, mineral waste, combustion residues and soil result in net Climate Change impacts, with plastic having the highest impact due to incineration. Conversely, metals, textiles, electronics, discarded vehicles, glass, paper/cardboard, and wood yield net savings, with metals achieving the highest savings due to minimal treatment burdens and substantial material recovery benefits.

This methodology provides a framework for measuring and accounting for emission reductions resulting from the recovery of waste. It applies to both offsetting and insetting use cases, enabling companies and project developers to credibly quantify the climate benefits of circular economy interventions and support the Scope 3 decarbonization efforts, and contribute to broader sustainability transitions.

1.2 Applicability of the methodology

- This methodology applies globally to interventions that recover waste [2] in order to transition to a circular economy.
- Project developers must prove that because of the intervention (e.g., project or program), the recovery of waste leads to the reduction of the net GHG emissions.
- Project developers must be transparent and provide proof of the source of their waste streams.
- For both the baseline and project intervention, project developers must provide proof of the emission factors (EFs) related to the specific characteristics and activities of the project.
- The waste must be collected or diverted from:
    - landfill
    - open burning
    - incineration (with or without energy recovery)
    - any other disposal or recovery route that would prevent the material from retaining more of its original value or function, such as low-efficiency recycling.
    - in some cases, the waste may be diverted from existing recycling pathways if the intervention demonstrably leads to a greater net reduction in GHG emissions (e.g., through refurbishment or reuse that preserves more embedded energy and function). The project developer must provide comparative evidence of the emissions performance between the baseline (e.g., recycling) and the project scenario (e.g., refurbishment).
- Project developers must ensure that the waste streams are properly sorted so that the recovery process handles only relevant materials.
    - Project developers must document how sorting is done and demonstrate that the sorted waste meets the needs of the chosen recovery technology. For example:
        - For mechanical recycling, sorted material should meet size, cleanliness, or polymer-type specifications.

[2] Waste recovery refers to the process of extracting value from waste materials by converting them into products, components, or feedstocks that can reduce the use of virgin resources in the economy. It includes a range of interventions such as recycling, upcycling, refurbishing, reprocessing, and other methods that allow waste to serve a new functional purpose.

        - For chemical or advanced processes (pyrolysis, depolymerization), sorting criteria should ensure minimal incompatible materials or hazardous contaminants.
    - Project developers must ensure only the relevant and recoverable fractions proceed, while contaminants, non-target materials, and hazardous substances are removed or managed separately. The fraction of the waste not meant to be recovered must be removed or treated according to relevant regulations, and cannot be included as part of the recovered output.
    - Project developers must demonstrate that their chosen method reliably produces a feedstock appropriate for the recovery technology and ensures traceability of sorted fractions. The methodology does not dictate one “correct” sorting approach.
- In case composite or hybrid fractions are used, these must not be mixed with higher-purity or easily recoverable streams, if doing so diminishes or prevents those purer fractions from being recovered in the future.
    - Specifically: Mixing composite recovered materials with pure fractions is permitted only under the condition that:
        - The resulting product meets the applicable industrial standards or sector-specific specifications for performance, safety, and quality (e.g., EN/ISO, ASTM, or equivalent).
        - A life-cycle assessment demonstrates that the blended material does not increase net greenhouse gas emissions compared to using pure virgin or pure recovered material.
        - If blending results in changes to product performance (e.g., durability, recyclability), the functional unit must be adjusted to ensure equivalence of service delivered.
        - Where uncertainty exists regarding environmental trade-offs, the more conservative assumption must be applied.
    - Project products which contain both virgin and recovered content are eligible under this methodology. In this case, the emission reduction must be calculated proportionately to the recovered proportion. In other words, the virgin share of the product must be accounted for as if no recovery took place. Moreover, the following conditions must be met:
        - (a) the recovered content must be traceable/verified,
        - (b) the recovered proportion must be documented for each reporting period,
        - (c) the emissions coming from the blending process must be accounted for.

- For example, some non-accepted scenarios include:
  - Mixing clean PET bottles (high-purity stream) with mixed plastics, which reduces recyclate quality and prevents bottle-to-bottle recycling.
  - Mixing aluminum beverage cans with composite aluminum–plastic laminates, which contaminates a well-established closed-loop system.

- Project activities must lead to waste being recovered and causing an emission reduction compared to the baseline as defined in this methodology.
- The methodology does not restrict waste recovery processes (mechanical processes such as shredding, melting or chemical recycling such as pyrolysis, depolymerization) to a fixed set of technologies, as long as they meet core criteria of improving resource recovery and displacing raw inputs.
- In case the waste recovery leads to the production of a new product that aims to replace an existing product, then a fair comparison and quantification between the two must be made. For this purpose, a functional unit must be defined as explained in section 4.1 Functional equivalence and comparative basis. This is the quantifiable output or service the product is intended to provide (e.g., one ton of insulation material, one cubic meter of packaging, etc.). Emission calculations in both the baseline and project scenarios must be based on this functional unit.
- The project developer must ensure that recovered waste is accurately quantified (e.g., by weighing) both at the point of entry into processing and at the facility's exit gate[3] (or, if not feasible, at the earliest practical measurement point).
  - For chemical or otherwise decomposed outputs (e.g., pyrolysis oil, devulcanized material), use mass-balance or similar methods to attribute the recovered fraction to the correct material types. The project developer must select and justify the mass balance method used. Some (non-exhaustive) example methods are ISCC PLUS / ISCC EU, and RSB (Advanced Products).
  - In multi-input processes, project developers must transparently document:
    - The total mix of inputs (e.g., fossil feedstock, bio-based feedstock, recycled waste fractions).
    - The allocation method used to distribute recycled content across outputs.
    - The resulting recycled share in each output stream.

[3] Depending on whether only one or multiple companies are involved, the exit gate is defined as follows:

- Single company: The exit gate is where outputs leave the company's direct control (e.g., shipment area, storage yard, pipeline custody-transfer point, or delivery acceptance by an external carrier).
- Multiple companies (recovery/substitution context): The exit gate is the point at which the recovered product meets the specifications required to replace the intended conventional product, and it is accepted for use or transfer as that substitute. At this point, recovery is deemed complete and responsibility for downstream use lies beyond the producer's operational control. This point may occur on-site (e.g., between co-located companies) prior to the product physically leaving the shared site.

    - Any non-recoverable leftovers or processing residues must be managed responsibly. This includes preventing uncontrolled emissions or discharges, minimizing environmental harm, and complying with applicable waste handling and disposal regulations. The project developer must justify the selected disposal route and ensure it meets comparable environmental standards.
- To ensure that the methodology prioritizes interventions with significant and credible climate benefits, project developers must provide a screening assessment of the waste streams in scope. This assessment must consider:
    - GHG impact potential: Likelihood of emissions if unmanaged (e.g., methane and nitrous oxide from organic waste in landfill, CO_2 from incineration of fossil-based plastics).
    - Material composition: Share of fossil-carbon content, biodegradability, or energy intensity of virgin equivalents.
    - Contamination level: Degree of impurities or hazardous substances that could affect recovery efficiency, safety, or downstream quality.
    - Recovery potential: Technical feasibility and scale of recovery, considering available technologies, market demand for outputs, and displacement of virgin materials.
- This methodology can work **synergistically** with other GHG methodologies or programs that target emissions reductions or removals in areas outside the scope of this methodology. In case this methodology is used in conjunction with other methodologies or programs then the project developer must:
    - explicitly mention that in the POD and
    - demonstrate that benefits are not quantified more than once
    - provide a separate monitoring framework to ensure that combined interventions do not undermine each other's effectiveness in long-term consistency
    - receive an agreement from Proba that the methodologies can indeed be combined, unless compatibility of methodologies is explicitly stated in one of the methodologies
- Project developers must ensure that the applicability, eligibility and additionality criteria presented in this methodology are fulfilled.
- This methodology can be used for both offsetting and insetting projects. In alignment with emerging SBTi guidance, projects should prioritize direct mitigation, where the intervention can be physically linked to specific emissions sources within the company's supply chain through a robust chain of custody model. Specifically, this is guided by *SBTi's Corporate Net-Zero Standard Version 2.0 Consultation Draft* [4] which prioritizes

[4] https://files.sciencebasedtargets.org/production/files/Net-Zero-Standard-v2-Consultation-Draft.pdf

direct mitigation when possible. When traceability to either specific emissions sources or the activity pool currently cannot be established, or if insurmountable barriers persist in addressing a source of emissions, this methodology also acknowledges the role of indirect mitigation as an intermediate measure. The traceability of the insetting activities can be ensured with activities such as chain-of-custody documentation, blockchain-based tracking systems, or third-party verified sourcing certificates. Section 1.4 Additionality, explains the requirements for these different types of projects.

- This methodology has been developed in accordance with the Proba Standard, ensuring that all guidelines, principles, and requirements outlined in the standard are fully adhered to. Users of this methodology are expected to follow the Proba Standard to ensure consistency, credibility, and compliance with the broader framework established by Proba.

1.3 Eligibility

1.3.1 Types of waste to be recovered

- In this methodology, the eligible waste streams are those destined for disposal (e.g., landfill, incineration, open burning, etc.) and are thereby prevented from getting recovered. Waste streams that are already being recycled may also be eligible if the proposed intervention demonstrably leads to a net reduction in greenhouse gas emissions compared to the existing recycling pathway.
- The following waste streams are eligible:
    - Post-production: by-products or scraps generated during the manufacturing and production process
    - Post-consumer: waste that results after a product has served its intended purpose and is no longer wanted or needed by the end user
- The methodology applies to any type of waste that meets the above criteria, regardless of material type.
- The following waste streams are non-eligible:
    - **Hazardous waste** as defined under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989) and corresponding national regulations (e.g., EU Waste Framework Directive 2008/98/EC, Annex III on hazardous properties).
    - **Mixed, non-source-segregated municipal solid waste (MSW)**, unless the project demonstrates effective pre-sorting into separate fractions (OECD, 2016).
        - Proof: Facility sorting records, contracts with municipalities, weighbridge data.
    - **Waste already mandated for collection or recovery** under Extended Producer Responsibility (EPR) schemes. In this case the intervention is not additional. In addition, waste materials imported from other countries from jurisdictions where recycling or recovery of such waste is already mandated by regulation are not eligible under this methodology.
    - **Waste streams that are classified as posing exceptional risks**, including asbestos-containing materials, persistent organic pollutants (POPs), radioactive waste, and infectious medical waste. Some example include:
        - Asbestos: International Labour Organization Asbestos Convention, 1986 (No. 162).
        - POPs: Stockholm Convention on Persistent Organic Pollutants (2001).
        - Radioactive waste: IAEA Safety Standards SSR-5 Disposal of Radioactive Waste.

        - Medical waste: World Health Organization: Safe management of wastes from health-care activities (2014).

- This methodology does not give any priority to specific types of waste. Nevertheless, it is expected that high-emission/ high-potential waste streams are prioritized by project developers. For example:
    - Plastics (multilayer, composites, contaminated streams): Often incinerated, with high fossil-carbon CO_2 release.
    - Rubber (e.g., tires): Energy-intensive virgin inputs; strong circularity gains through recovery.
    - Metals: Lower baseline end-of-life emissions but high virgin extraction/processing footprint, so recovery yields large avoided emissions.
    - Organic waste: High methane and nitrous oxide generation potential in landfills.
- To ensure environmental integrity, the project intervention must demonstrate a minimum 5% reduction in emissions per functional unit compared to the baseline scenario. This threshold applies at the unit level (e.g., per tonne of recovered material) and not only at aggregated project volume. Activities delivering less than a 5% reduction relative to baseline are not eligible for crediting under this methodology.

1.3.2 Types of recovered products

- The functionality of the recovered products must be assessed compared to the baseline counterpart. This means they must meet the necessary performance standards for its intended application. If functional equivalence is lower than that of the virgin counterpart, the quantified emission reductions must be adjusted proportionately to reflect the reduced performance or service delivered.
- To ensure comparability between baseline and project products, the project developer must demonstrate functional equivalence. This requires an assessment of product performance and the following additional lifecycle factors (if applicable):
    - **Durability** – expected service life and replacement needs.
    - **Usability** – ease of use, compatibility with standard practices, and user acceptance.
    - **Safety** – occupational and end-user safety risks during production, handling, or application.
    - **Service life** - Incorporating the expected lifespan of the product to ensure a fair assessment of long-term carbon impacts.
    - **Recyclability / end-of-life management** – potential for recovery, reuse, or recycling of the product and its packaging.
    - **Reliability / consistency** – ability of the product to consistently meet required specifications.

    - **Compatibility / interoperability** – integration with existing systems, inputs, or practices.
- The project developer must:
    - Address each factor in the equivalence assessment. If a factor is not relevant to the specific product, this must be explicitly explained and justified.
    - Provide sufficient evidence for comparison between baseline and project products. Evidence may include peer-reviewed literature, independent testing reports, Environmental Product Declarations, LCA studies, or other verifiable sources.
    - Document all assumptions and any uncertainties associated with the assessment.

1.3.3 Regulatory compliance

- Project developers must provide evidence that recovery processes and recovered products comply with all relevant local and national regulations. Specifically we identify two levels of compliance:
    - Process compliance: Recovery facilities and operations must hold valid permits, licenses, or equivalent authorizations required under local law.
    - Product compliance: Recovered products must meet all regulatory requirements in the jurisdiction(s) where they are marketed, sold, or applied.
- Project developers must provide, at a minimum,
    - valid operating permits/licenses for recovery processes,
    - product registration/approval certificates, and
    - safety data sheets (SDS) for recovered products.
- Where applicable, developers must also provide:
    - compliance certificates,
    - inspection reports, or
    - other official documentation required under local law.
    - Additional supporting evidence (such as environmental impact assessments or registry declarations) may be provided to further substantiate compliance.
- Where such evidence is not available, project developers must clearly justify why and provide alternative documentation.
- Where local regulatory frameworks are absent, incomplete, or weakly enforced, project developers must demonstrate compliance with internationally recognized environmental, health, and safety standards (e.g., ISO, IFC, EU thresholds). In this case, the verifier must ensure that the selected standards fit the scope of the project.
    - Accepted evidence may include:
        - third-party certifications (e.g., ISO 14001/45001),

    - independent laboratory tests against international contaminant and safety thresholds, or
    - equivalent safeguards documented through accredited NGO or development agency oversight.
  - Developers must disclose the absence of adequate local regulation, justify the alternative standards used, and provide verifiable documentation for comparison.

1.4 Additionality

Additionality refers to the concept that a GHG reduction project should result in emissions reductions beyond what would have occurred under a "business-as-usual" scenario or existing regulations, ensuring the reductions are truly "additional" and not simply complying with mandatory requirements.

Project developers are encouraged to use:

- the *Proba Additionality Assessment Template* [5] to assess and demonstrate additionality, as defined in section 3.6 of the Proba Standard.
- Alternatively, established tools and approaches can support project developers in assessing additionality, particularly for financial and common practice assessments. These include:
    - the UNFCCC's CDM Tool for the Demonstration and Assessment of Additionality (Version 07.0) [6] and
    - the CDM Tool for Common Practice (Version 03.1) [7].

      These tools offer structured guidance for conducting barrier analyses, determining financial attractiveness, and assessing market penetration levels of a given practice. While originally developed for offsetting contexts, they can be adapted for insetting projects when transparently applied and justified in the POD.

Depending on whether the project developer aims to use the generated claims (emission reduction certificates) in either offsetting or insetting scenarios, different requirements apply.

For the offsetting scenario the project developer must prove the following three aspects of additionality:

- <u>Regulatory additionality</u>: The project developer must prove that the intervention was not caused by local, regional or national regulations.
    - To achieve that, the project developer must make sure there is a) no regulation mandating the recovery of the waste stream and b) there is a lack of financial incentive of regulatory directives to realize the proposed intervention. If subsidies are available, the project developer must show that available funding does not cover the financial gap to realize the intervention.
    - If a project falls under planned regulations, additionality can still be achieved if the project can prove its intervention goes beyond the set goals or realizes its impact ahead of the planned regulation timeline. In this case, the project may

[5] https://proba.earth/hubfs/Project_Design/Proba_Additionality_Assessment_Template.pdf
[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf
[7] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-24-v1.pdf

only be additional for a limited time until the regulation comes into effect and becomes business-as-usual.
    - If a regulation is implemented during the crediting period that mandates the recovery of products, the crediting period for the project will end at that point, as the project would no longer meet the criteria for additionality.
    - Project developers must transparently disclose any (upcoming) changes in the regulatory landscape relevant to the recovery process or recovered products throughout the crediting period and report on them in each verification report; if no changes have occurred, this must be explicitly stated to ensure transparency and consistency.
- Prevalence: The project developer must prove that the intervention is not a common practice in each region included within the project area [8]. Common practice is defined as per the guidelines of the Standard that the project developer follows. For instance, this can be achieved by:
    - Demonstrating that manufacturers in the region typically opt for virgin inputs due to factors like reliability, quality concerns, or pricing.
    - Providing evidence (e.g., surveys, interviews, industry reports) showing low adoption of recovered feedstock under normal market conditions.
    - Identifying key obstacles (e.g., inconsistent supply, lower quality, lack of standards) that hinder the use of recovered materials.
    - Showing how the project overcomes these barriers (e.g., improved sorting, better quality control, stable supply contracts).
- Financial additionality: The project developer must prove that the financial incentive from carbon finance will lead to the increased adoption of the waste recovery method. Transparency on financial assistance, such as subsidies, is also required. This financial analysis may be treated as confidential by the VVB and Proba and is not required to be published in the public registry.

For the insetting scenario, the Project Overview Description (POD) must be transparent and document information on:

[8] By default, the appropriate geographic boundary for common practice analysis, baseline determination, and project assessment shall be defined at the country level.
In cases where the project developer operates across multiple countries or where the recovery process is more appropriately assessed at a broader or narrower scale, the boundary may instead be defined at:
- A multi-country level, where this better reflects the operational or market context of the project; or
- A regional level within a country, if recovery practices, regulations, or market dynamics are distinct from the national average.

Any deviation from the default country-level boundary must be clearly explained and justified in the Project Overview Document. The justification must include the rationale for selecting the boundary, supporting evidence of its relevance, and an explanation of how it ensures fair and consistent comparison between baseline and project activities.

- Prevalence additionality: An explanation must be provided that the use of the waste recovery method is not a common practice within the company's sourcing region or market segment relevant to the intervention.
- Financial additionality: An explanation must be provided that carbon finance is positively affecting the use of the waste recovery method within the company's sourcing region or market segment.

The Validation and Verification Body (VVB) must assess and validate the additionality claims presented by the project developer, including both the prevalence analysis and the financial analysis. In doing so, the VVB is required to confirm that the data sources, assumptions, and calculations used are credible, transparent, and consistent with the methodology’s requirements. The VVB must document its assessment in the validation report, apply a conservative approach where uncertainties exist, and request clarification or additional evidence if the information provided is insufficient to substantiate the additionality claim.

Notes:

- Additionality must be reassessed when renewing the crediting period to confirm that the project remains eligible under the Proba Standard. Project developers are responsible for monitoring regulatory changes, financial conditions, and market adoption that may affect the project’s additionality. For every verification event project developers must confirm whether there have been any regulatory changes that may affect the project’s additionality. In addition, the crediting period is designed to reflect the changing nature of financial additionality and prevalence. As market conditions and adoption rates evolve, these factors are re-evaluated when the crediting period is renewed to confirm the project’s continued eligibility.
- The methodology requires that each Project Overview Document (POD) provides a clear description of how traceability of the supply chain and the chain of custody (CoC) model will be ensured at project level. This includes explaining how emission reductions and other project outcomes are tracked from the point of origin through to the final claiming entity within the insetting framework.
- To mitigate the risk of double counting or invalid scope 3 claims, the Proba platform incorporates a blockchain-based registry. This registry records all issued units, transfers, and retirements in a transparent and immutable manner, thereby supporting the integrity of supply chain claims. While the platform provides this safeguard, it is ultimately the responsibility of the reporting company’s auditor to assess and verify that the scope 3 claims made are plausible and in line with accounting standards. The platform serves to support, but does not replace, this assurance process.
- With respect to chain of custody models, the methodology does not prescribe eligible models, as appropriate models may vary by supply chain and project type. Instead,

project developers are expected to identify and apply the most suitable CoC model for their specific context (e.g., physical segregation, mass balance, or book-and-claim), and to justify this choice in the POD. The chosen model must ensure that the environmental benefits claimed by the reporting company can be credibly traced back to the originating activity, and that no double allocation occurs.

1.5 Crediting period

The crediting period is the timeframe during which a validated project can generate emission reduction certificates. After the end of the crediting period, the project needs to be re-validated, to ensure that additionality is still present, the baseline scenario is reassessed, and the project complies with the latest version of this methodology.

For GHG projects recovering waste, the crediting period can be set for up to a maximum of **5 years**, depending on trends in the regulatory and industry landscapes towards circular economy practices. In industries where technologies, regulations, or market practices evolve rapidly, project developers must define a shorter crediting period, reflecting the higher likelihood that the project activity becomes common practice or is superseded by improved solutions. This approach ensures that crediting periods remain aligned with real-world developments, while still providing sufficient time for projects to demonstrate their environmental impact and allowing flexibility for project adjustments and improvements (e.g. the introduction of new technologies or regulatory changes).

Renewals of the crediting period are permitted and may be carried out multiple times, provided that each renewal follows a full re-validation process and continues to meet the applicability criteria, methodological requirements and alignment with Proba standard and the latest version of the GHG methodology.

To avoid double counting, emission reductions that have already been claimed, credited, or otherwise accounted for under another mechanism, program, or system prior to the project's registration are not eligible for crediting under this methodology.

Retroactive crediting

This methodology allows for retroactive crediting, in case the waste recovery was realized within a maximum of **one year** prior to the submission of the validation of the POD.
In such cases, the crediting period will begin at the moment the intervention was first implemented, provided that the project developer can fulfill the requirements set by this methodology (e.g., proof of additionality, baseline, scientific evidence, documentation etc.) and

in addition demonstrate that the intervention was implemented with the intention of utilizing carbon finance.

1.6 Co-benefits & no harm principle

This methodology does not prescribe any calculation methods for quantifying additional benefits resulting from the recovery of waste. Project developers are recommended to report on co-benefits for credibility purposes.

Proba encourages GHG projects to contribute to at least one or more UN Sustainable Development Goals, and expects that project developers will consider these when preparing and designing a project.

Project developers are encouraged to engage in projects that help underserved regions (like many LDCs or SIDS) that lack adequate local recycling.

If the project developer aims to claim one or more co-benefits, these must be clearly defined in the Project Overview Document (POD), along with how the impact is achieved, measured (e.g., through KPIs[9]). In this case, relevant KPIs must be selected by the project developer and monitored throughout the years.

Project developers should specify the co-benefits in POD before validation and report on them yearly as part of verification.

Project developers must adhere to the "*Environmental and Social do no harm principle*" by conducting thorough assessments to identify and evaluate potential environmental and social impacts of their GHG projects. *Proba's environmental and social do no harm principle template* can be used for this purpose.

Project developers must implement mitigation measures for any identified risks or negative impacts, to ensure the project does not harm local ecosystems or communities, especially vulnerable groups. In addition to GHG emissions, potential impacts on environmental and human health must be assessed and addressed, including risks such as eutrophication, toxicity, or particulate matter emissions. The Project Developer can use the *Risk Evaluation Template for waste recovery projects*[10] to report the risk assessment systematically along with the risks outlined in section 1.7 Risks.

[9] KPIs (Key performance indicators) measure a company's success vs. a set of targets, objectives, or industry peers
[10] The template can be shared upon request and is intended only as guidance. It is the developer's responsibility to complete the full risk assessment, and either the developer or the VVB may introduce additional project-specific risks that should be considered.

As such, in the POD, at least the following must be established:

- monitoring frequency - at least once during the crediting period
- relevant risk indicators
- corrective pathways if harm is detected.

The VVB bodies must then:

- assess the co-benefits and ESDNH monitoring plan during the POD review
- check the progress of the plan (as defined in the POD) and the possible corrective actions during the yearly verification

1.7 Risks

The project developer must provide:

- a **risk analysis** that identifies every potential risk factor that may cause the project to under/over-deliver against its stated GHG reduction claims. The *Risk Evaluation Template for waste recovery projects* [6] can be used to evaluate each risk, assign both a likelihood score and a severity score, and justify those scores in writing.
- a **mitigation strategy** that outlines the preventive controls for all identified risks . Any risk receiving a “high” or “very high” combined score must be covered by a mitigation plan that specifies *both* preventive controls and corrective actions. This strategy must describe in detail how the developer will mitigate, monitor, report on, and, when required, compensate for any technical, environmental, or social harm arising from the risk. For certain risks that pose significant environmental or social concerns, the developer may be asked to supply further evidence in support of the mitigation approach.

Risks that need to be addressed only for large-scale projects (defined as having a net impact of more than 250,000 tCO_2e/year):

- **Overproduction of new, unused products misclassified as waste**
    - There is a risk that the generation of carbon credit revenues could incentivize the intentional overproduction of low-value or unused products, which may then be misclassified as “waste” to qualify under this methodology. This would undermine the environmental integrity of the project by crediting activities that do not represent actual waste diversion.
    - For large-scale projects, this risk is considered significant and must be explicitly addressed. In such cases, project developers must propose a mitigation strategy that ensures no crediting of overproduction.

- As an additional safeguard, the methodology requires (see Section 1.2 Applicability) that project developers provide transparent documentation and verifiable proof of the origin of all waste streams used. This traceability requirement supports the prevention of overproduction being counted as eligible waste diversion.

- **Activity shifting within the waste management chain**
    - There is a risk that, instead of reducing virgin material production, the recovered product may simply lead to virgin production being redirected to other markets or applications. In such cases, the intended displacement effect may not fully occur, undermining the project's additionality. As this effect is highly uncertain and cannot be reliably quantified, it is treated as a risk rather than as a leakage adjustment.
    - For large-scale projects project developers must assess the likelihood of this risk in their sector and propose mitigation measures.

Buffer pool specific to this methodology:

- As per the Proba Standard, this methodology defines the standard contribution to the Buffer Pool to 10%, mainly to address risks associated with incorrect monitoring of data.
- If a project presents very high risks that cannot be fully mitigated through prevention or control measures, an increased buffer pool may be required to provide additional assurance. In such cases, the size and structure of the buffer pool should be determined based on the project's specific risk profile and agreed upon during validation.

Notes:

- Risks identified in the project risk assessment that remain unmitigated or are realized during the crediting period must be transparently reported in the monitoring reports. Where such risks result in reduced recovery volumes, increased emissions, or otherwise compromise the project's performance, the associated emission reductions must be adjusted downward accordingly to reflect verified outcomes. Risks that do not materialize or that are effectively mitigated do not affect the calculation of emission reductions.
- The risk assessment must be updated as per the Proba Standard.

1.8 Leakage & permanence

1.8.1 Leakage

Leakage in the context of a GHG project is the net increase in GHG emissions that occur outside the project boundary (see section 2 Project boundary), directly resulting from the project's activities (IPCC, 2006).

Waste recovery and upcycling projects can interact with existing markets and supply chains in ways that may unintentionally cause emission increases elsewhere. The following leakage risks are relevant to such projects and must be assessed by the project developer.

1. **Activity shifting within the waste management chain**: There is a risk that introducing new recovery or upcycling activities may displace existing recycling, composting, or waste treatment operators, especially in regions with limited or informal waste markets. This may cause the displaced activities to reduce output or relocate, potentially increasing emissions outside the project boundary. This risk is addressed under section 1.7 Risks, where project developers are required to assess the likelihood and significance of such displacement within the local waste system. If the risk is deemed significant, developers must design and implement mitigation measures to prevent adverse effects.
2. **Virgin production shift (market leakage)**: There is a risk that recovered products do not displace virgin material production, but rather lead to its redirection to other markets or applications. In this case, the expected substitution and related emission reductions would not fully occur [11].

Table 1: Market leakage deduction for different scenarios

Scenario	Project scale [12] Net emission reductions (tCO_2e/year)	Deduction
A	Small-scale <10,000	0%
B	10,000 - 250,000	5%
C	>250,000	10%

[11] These deductions act as temporary conservativeness buffers, not as direct leakage estimates. They are intended to ensure environmental integrity where market effects cannot be conclusively ruled out.
[12] The project scale classification is based on commonly observed thresholds in land-based GHG methodologies, where projects below 10,000 tCO_2e/year are typically considered small-scale with negligible market influence, while projects above 250,000 tCO_2e/year are likely to affect regional supply chains.

Note 1: Reversibility of deductions

The conservativeness deductions applied under this section are reversible. After a period of four years from the project's initial crediting, the project developer may submit evidence demonstrating that the project has not resulted in material displacement, market disruption, or increased virgin material use elsewhere.

If this evidence is accepted by the Validation and Verification Body (VVB) or program authority, the previously deducted emission reductions may be:

- Credited retroactively, or
- Released from a buffer pool, if one is used.

If adequate evidence is not provided, the deduction remains permanent.

Acceptable evidence may include:

- Market or industry data showing no increase in virgin production volumes.
- Third-party market or trade analyses confirming stable or declining virgin supply.
- Verified supply chain or procurement records from downstream users demonstrating actual substitution of virgin materials.
- Independent expert or governmental reports confirming no material market displacement.

Note 2: Rationale and limitations

The approach above aims to balance environmental integrity with practical feasibility.

- Market-related leakage and activity-shifting effects are real but difficult to quantify reliably at the project level.
- The tiered deduction system introduces conservativeness proportional to the project's scale and the quality of supporting evidence, avoiding arbitrary penalty while ensuring robustness.
- The reversibility mechanism encourages project developers to collect and submit additional evidence over time, allowing conservative deductions to be lifted where the displacement risk proves insignificant.

This structure ensures that large-scale projects with higher systemic influence face stricter scrutiny, while smaller or well-documented projects are not unduly penalized.

1.8.2 Permanence

The intervention focuses on the reduction of GHG emissions through the diversion and recovery of waste materials that would otherwise decompose or be incinerated, leading to emissions. Once the waste is recovered in a way that prevents its degradation or combustion, the potential for it to emit greenhouse gases (such as CH_4 or CO_2) is permanently avoided for that waste stream.

Since these reductions result from a one-time prevention of emissions, rather than carbon sequestration or storage, the risk of reversal is not applicable.

2 Project boundary

2.1 Scope of activities

This methodology applies to project activities that recover waste materials otherwise destined for disposal (e.g., landfill, incineration, open burning), and reintroduce them into manufacturing processes as substitutes for virgin raw materials.

Project activities in scope include:

1. Recovery of internal post-production waste (stream X)
2. Recovery of internal post-consumer waste (stream Y)
3. Recovery of external post-production waste (stream Z)
4. Recovery of external post-consumer waste (stream W)

The project must demonstrate that the recovered material replaces virgin input or avoids disposal emissions. All four waste streams are eligible as long as they meet the criteria defined in Section 1.3 Eligible products and result in net GHG emission reductions. The intervention may lead to both avoided and added emissions across different lifecycle stages, as shown in *Figure 1.*

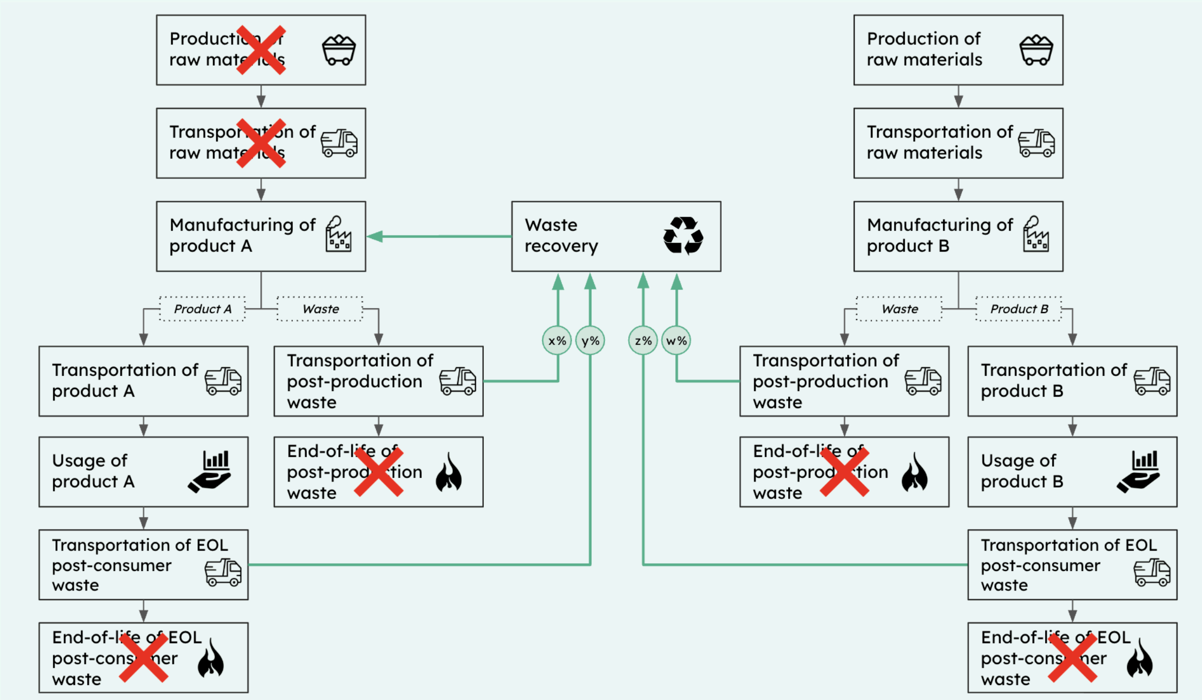

Figure 1: Scope of interventions based on the source of the waste.

Note: An activity marked with a red *X* on *Figure 1* means that the emissions related to the marked activity are avoided. Of course, the avoidance may apply only to a portion of the total waste stream. This is the case when only part of the recovered material is of sufficient quality or traceability to be used as a direct substitute for virgin materials. In such cases, the emission reductions from avoided raw material use must be quantified proportionally, based on the share of the recovered output that demonstrably displaces virgin input.

2.2 GHG sources

This methodology covers the GHG emissions associated with each relevant stage impacted by the intervention. Depending on the specific project setup and data availability, the following emission sources may be included:

Table 2: Emission sources covered under this methodology

Activity / Source	*GHG*	*Included*	*Justification*
(1) Production of raw materials (baseline only)	CO_2e	Yes	Avoided emissions from extraction and processing of virgin materials.
(2) Transportation of materials	CO_2	Yes	Changes in transportation emissions due to new collection, processing, or product delivery routes.
	CH_4/N_2O	No	Typically not material for transportation activities.
(3) Waste recovery process	CO_2e	Yes	Emissions from sorting, cleaning, mechanical or chemical recycling.
(4) Manufacturing of final product (if affected)	CO_2e	Conditional	Only included if recovered inputs cause a change in manufacturing emissions (e.g., processing energy).
(5) End-of-life treatment of waste	CO_2, CH_4, N_2O	Yes	Emissions avoided by preventing landfill, incineration, or open burning of waste.

During the project validation, the technical expert from the VVB must ensure that all the relevant emissions in scope are covered.

A third party verified LCA can be used as input for the quantification of emissions.

The type and magnitude of emissions in scope can vary significantly depending on the material type, disposal method, recovery process, and industry context. For example, methane (CH_4) emissions may be relevant for organic waste sent to landfill, while CO_2 may dominate in energy-intensive material production, and N_2O may be associated with certain chemical processes. It is the responsibility of the project developer to identify and include the relevant GHGs for their specific project, based on material characteristics, intervention type, and applicable emission factors.

For some waste streams, only part of the recovered output may be suitable for direct substitution of virgin materials. In such cases, emission reductions from avoided raw material use must be quantified proportionally.

For multicomponent materials the following apply:

- Default approach – conservative mass allocation: Emissions shall be allocated proportionally to the mass of the recovered versus non-recovered fractions. This provides a conservative and transparent basis for allocation.
- Flexibility for project developers: Project developers may apply more refined allocation approaches (e.g., energy content, economic value, process-specific yield factors) where robust data are available and can be validated by the VVB.
- Non-recovered fractions: Any emissions associated with disposal, treatment, or processing of the non-recovered fractions must be accounted for in the project boundary to avoid underestimation of net emissions.

Materiality Threshold for Exclusions

- To balance accuracy with practicality, the methodology establishes a materiality threshold for excluding minor emission sources. Project developers may exclude emissions from specific sub-stages (e.g., short-distance transport, small-scale packaging, auxiliary inputs) if the combined impact of these sources is less than 5% of total project emissions reductions.
- This threshold ensures that immaterial sources do not create unnecessary data collection burdens, while still safeguarding the environmental integrity of the credited reductions. Any exclusions must be transparently documented, and project developers must demonstrate through reasonable estimates that omitted sources fall below the threshold.

All emissions must be reported in CO_2-equivalent (CO_2e) units, using activity-specific emission factors where available.

2.3 Spatial boundaries

The spatial boundaries of a project are defined by the geographic areas where activities occur that impact greenhouse gas (GHG) emissions. These must include all relevant locations involved in the lifecycle of both the recovered and the baseline (conventional) product.

Project boundaries must account for the following stages:

- **Raw material and waste source locations**: This includes virgin material extraction or production sites in the baseline scenario, as well as all locations where waste is generated or collected. Examples include manufacturing plants producing off-spec or rejected (post-production) material, and municipal or industrial post-consumer collection points.

- **Sorting facilities**: If sorting is conducted separately from the recovery process, these facilities must be included, as they influence material quality, recovery rates, and related emissions.
- **Processing and manufacturing sites**: These include waste recovery plants where shredding, granulating, chemical recycling, or remanufacturing occurs, as well as baseline manufacturing facilities that would have used virgin raw materials in the absence of the project.
- **Product distribution and downstream supply chain**: If the project intervention affects warehousing, packaging, or distribution (e.g., due to changes in volume or logistics), those emissions must be included.
- **Usage sites (if applicable)**: If the recovered product is used in a specific application with geographically defined impacts (e.g., construction materials, packaging, components) that leads to different emissions compared to its virgin counterpart, these locations must be part of the boundary, particularly when relevant for assessing performance or end-of-life scenarios.
- **End-of-life management**: If the upcycled or recycled product differs in end-of-life fate compared to its virgin counterpart, this must be reflected. This includes disposal pathways such as landfill, incineration, reuse, or further recycling.
- **Transportation between stages**: All relevant transport emissions between the above stages must be included. This encompasses waste collection, raw material transport, movement of intermediate products, and final product distribution.

The spatial boundary is flexible in scale, as it may involve one facility or span multiple sites and countries, so long as all relevant emission sources and impacts are captured. Project developers must transparently justify the selected boundaries in the Project Overview Document (POD), considering factors such as material traceability, data availability, waste type, and end-use context.

If multiple scenarios (e.g., different material types, recovery methods, or product applications) are included in the same project, the spatial boundaries must be defined clearly for each scenario. Emissions must be calculated separately to ensure consistency and accuracy.

Finally, the spatial boundaries must be set to include all potential sources of leakage, and should consider local or regional regulatory requirements or environmental constraints.

In developing regions, project boundaries must explicitly consider informal systems of collection, sorting, and disposal. Excluding these activities could lead to an underestimation of emissions or misrepresentation of waste flows. Project developers are therefore required to identify and include informal practices where they are material to the project boundary. In doing so, developers may draw on local market knowledge, stakeholder input, and guidance from the VVB.

2.4 Temporal boundaries

The temporal boundaries define the time period during which emissions are monitored, quantified, and reported. These boundaries must align with the project's operational cycle and the timing of material recovery, processing, and substitution.

The **recommended monitoring (verification frequency) period is one year,** but this may vary depending on the type of waste, the recovery process, and the nature of the final product. Regardless of the reporting cycle, emission reductions must be calculated over the full life cycle of the recovered product compared to its conventional counterpart. To clarify:

- Baseline Scenario: For each waste stream included in the project, a baseline scenario shall be defined at the start of the crediting period and shall remain fixed for its duration. If a new waste stream is introduced during the crediting period, a baseline must be established for that stream at the time of inclusion and remain fixed for the remainder of the period. Where the sourced waste streams remain unchanged, no updates to the baseline are required. See also extension of scope according to the Proba Standard (section 4.3).
- Project Scenario: Project scenario emissions shall be monitored as per the defined verification frequency. Monitoring must reflect the volume and type of waste recovered, as these parameters determine the emission reductions achieved.

The methodology focuses on the recovered material or component, not the entire product in which it is embedded. However, the life cycle stages that must be accounted for include:

- **Raw material stage**: Extraction and processing of virgin inputs (baseline) vs. collection and preparation of waste (project) [13].
- **Manufacturing stage**: Conventional production process vs. the upcycling or recycling process.
- **Usage stage**: Performance and service life of the recovered and baseline product.
- **End-of-life stage**: Disposal or further recovery of the product or material.

When direct monitoring of the usage or end-of-life stage is not feasible, project developers must apply standardized assumptions based on credible sources, including:

- Product Carbon Footprint (PCF) or Life Cycle Assessment (LCA) reports,

---

[13] Preparation of waste refers to all processes required to recover waste, including sorting, cleaning, and any other necessary pre-treatment steps.

- Peer-reviewed studies,
- Regulatory frameworks,
- Industry benchmarks or best practices

If the recovered product differs from the baseline in **durability, performance, or functionality**, the emission reduction calculation must be adjusted accordingly. For example, if the recovered product has a shorter lifespan, the model must reflect the need for more frequent replacements (see section 4.1.2 Reference Service Life).

Project developers must transparently document all assumptions and data sources used to define the temporal boundary and model life cycle impacts, and must ensure consistency with the project's stated scope and functional unit.

Project developers are required to specify the monitoring intervals for all relevant activities as per the Proba Standard (sections 4.2 and 4.5). Any deviations from the specified intervals must be clearly justified.

The VVB shall ensure that the chosen interval is appropriate and sufficient to produce reliable monitoring data for each parameter.

3 Baseline scenario

The baseline scenario represents the emissions that would occur based on the business as usual waste management practices. In other words, this includes the fate of the waste, **without the introduction of the waste recovery process**.

The project developer must establish the baseline based on the following approach:

- The baseline scenario represents the **counterfactual** emissions pathway, or in other words what would have happened to the waste in the absence of the project's waste recovery intervention. It reflects the business-as-usual (BAU) practices in the region, including typical end-of-life (EOL) treatment methods such as landfilling, incineration, or unmanaged dumping. This approach ensures that the project only claims emission reductions that are additional to what would have occurred without it.
- The baseline must be defined based on the types and quantities of waste recovered and their likely fates under BAU conditions. These fates must be supported by historical information, regional practices, market evidence, financial drivers or waste management statistics. Specifically, the following fallback hierarchy must be followed:
    a. Historical data: An average of how the specific waste stream has been treated over the past 5 years.
    b. Regional data: An average of how this waste stream has been treated within the relevant region of the country over the past 5 years.
    c. National data: An average of how this waste stream has been treated nationally over the past 5 years.
- In addition, the following requirements apply:
    a. A 5-year average shall be used where possible. If unavailable, preference must be given to the most recent representative average data.
    b. Where no data meeting the above requirements are available, the project developer shall use the best available and most representative information to define the baseline fate. The adequacy and credibility of such data must be justified in the project documentation.
- The following emission sources must be included in the baseline:
    a. Transportation of waste to baseline EOL destination:
        - Based on the baseline fate analysis, transportation emissions shall be calculated.
        - These may only be credited if the waste is first transported to the recovery location before it would otherwise have been sent to its EOL destination.

- If the waste is collected directly from its typical EOL location (e.g., landfill), then these emissions cannot be included, as they have already occurred.

b. EOL emissions of waste
- After generation, waste may follow different end-of-life (EOL) pathways as determined in the baseline fate analysis.
- The share of waste entering each pathway shall be estimated, and corresponding average emission factors applied to calculate baseline EOL emissions.

c. Production of raw materials
- Recovered waste substitutes raw materials in scope.
- The avoided emissions associated with extraction and processing of these raw materials shall be calculated.

d. Transportation of raw materials
- The avoided transportation emissions of the raw materials replaced by the recovered waste shall also be estimated.

Where multiple options or data sources are available, conservative estimates must be used, to avoid overestimating the impact of the project interventions [14].

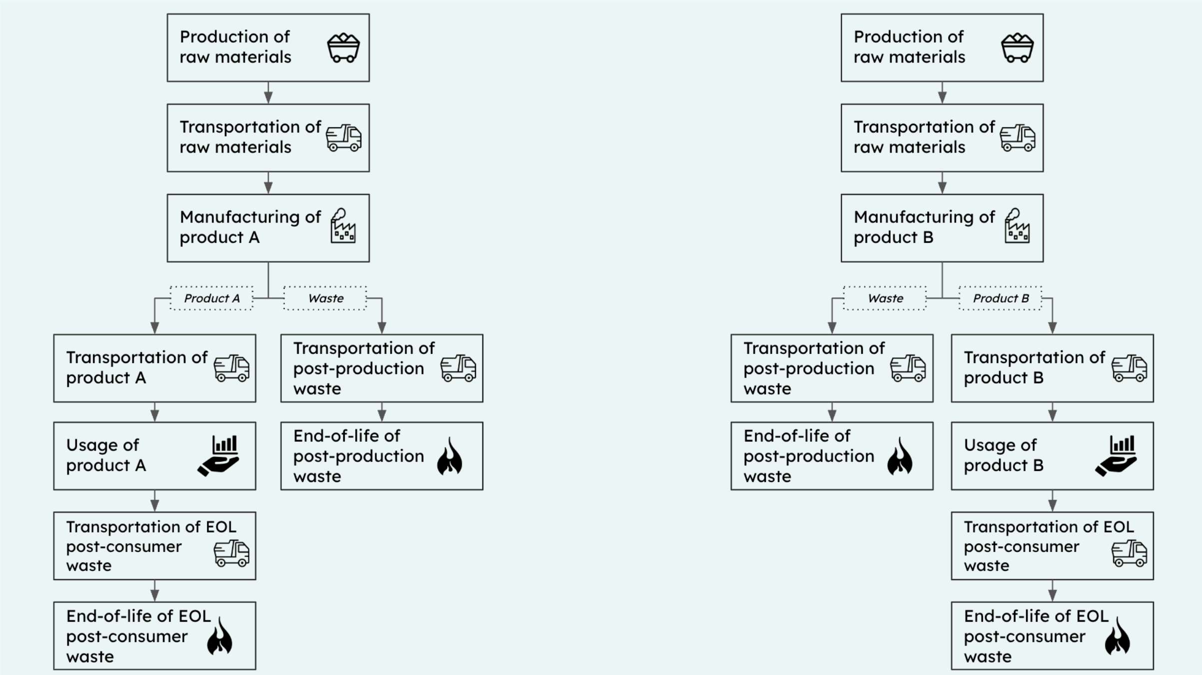

Figure 2: Baseline visualization. Different baseline routes that must be accounted for, depending on the source of the waste.

[14] Specifically, the project developer must select the emission factors, volumes and any other relevant data so that the total baseline emissions are not overestimated and the total project emissions are not underestimated.

Notes:

1. Emission sources that are identical between the baseline and project scenario, such as the usage phase, if unchanged, may be excluded from quantification.
2. If the difference between baseline and project transportation emissions for waste is immaterial (below the materiality threshold as defined in section 2.3), these may be considered to cancel each other out and excluded from MRV, simplifying monitoring.
3. The same assumption applies for transportation of raw vs. recovered materials, subject to the materiality threshold.
4. All baseline emission sources listed above must be calculated regardless of whether the waste originates from the same supply chain or from an external one (see Figure 1).
5. For waste that is sourced from multiple streams, all associated baseline emission activities (transport, EOL, etc.) must be calculated proportionately to the share of waste coming from each stream. For instance, A project recovers 100 tonnes of waste to replace raw material A. Of this waste, 70 tonnes are sourced from Stream B and 30 tonnes from Stream C. The baseline emissions from transport, EOL, and other activities must therefore be calculated separately for Stream B (70%) and Stream C (30%), and then combined. The avoided emissions are then compared against the total substitution of 100 tonnes of raw material.

4 Calculation of GHG emissions

The project developer must calculate the **total GHG emissions** for both the baseline and project scenario. These emissions must be transformed into tonnes of CO_2e for each verification period (see Appendix B: CO_2e and Global Warming Potential).

4.1 Functional equivalence and comparative basis

The calculation of GHG emissions must be based on a transparent and credible comparison between the baseline and project scenarios. In this methodology, the baseline product refers to the conventional product that would have been used in the absence of the project, while the project product refers to the material or component produced through waste recovery.
Emission calculations must reflect differences in product function, quantity required, lifecycle duration, and end-of-life treatment. In cases where the recovered product is a direct substitute for the baseline product, a 1:1 replacement ratio may apply. However, if the recovered product differs in performance or lifespan, adjustments are required to maintain a consistent and credible basis for comparison.
The following elements must be explicitly addressed in the Project Overview Document (POD) and incorporated into the emission calculations for the baseline, project, and resulting emission reductions.

4.1.1 Functional performance

- Project developers must first establish that the recovered product meets the same functional requirements as the baseline (replaced) product. Functional performance refers to the specific service or outcome the product is designed to deliver. This will vary depending on the product category. For example, thermal insulation materials must meet defined thermal resistance values, while structural components must support comparable mechanical loads.
- The POD must define the functional requirements relevant to the baseline product and provide evidence that the recovered product satisfies these same criteria. This may include technical specifications, material property data, laboratory test results, or third-party certifications.

4.1.2 Reference Service life (RSL)

- The expected service life of the recovered product must be considered in relation to that of the baseline product. This includes the Reference Service Life (RSL), defined as the period during which the product performs its intended function under standard use conditions without significant deterioration or maintenance.

- Durability must be demonstrated through evidence of the recovered product's ability to maintain its performance throughout the expected service life. Where the recovered product is less durable, this difference must be reflected in the calculations by accounting for additional replacements or maintenance requirements.
- If the RSL of the recovered product differs from that of the baseline product, this difference must be reflected in the emission calculations. For example, if the recovered product lasts half as long, the emissions from producing and disposing of two units must be included to maintain comparability with a single unit of the baseline product.
- Evidence supporting the claimed service life must be provided in the POD. This may include manufacturer data, peer-reviewed studies, field trials, or established LCA parameters.

4.1.3 Substitution ratio

- In cases where the recovered product does not replace the baseline product on a 1:1 basis, the substitution ratio must be adjusted to reflect actual usage or material input. This may be necessary when the recovered product differs in mass, density, coverage area, or functional yield[15] .
- Project developers must clearly justify the substitution ratio using measurable parameters that demonstrate effective material performance in the intended application. This refers to how efficiently the recovered product fulfills the same service or utility as the baseline product, based on the physical characteristics and performance data described in Sections 4.1.1 and 4.1.2. Any assumptions made must be documented and supported by data or relevant industry benchmarks.
- The substitution ratio is used in section 4.2.1 to calculate the virgin material displacement.
- The project developer must prepare a clear list of functional requirements for the baseline product and demonstrate that the recovered product meets these same requirements. During validation, the Verification and Validation Body (VVB) must confirm that the selected functional requirements are appropriate and sufficient for the intended application.

4.1.4 End-of-life differences

- End-of-life (EOL) considerations address the stage following the RSL of the product, focusing on emissions and treatment processes that occur once the product can no longer fulfill its intended function. This differs from the RSL, which concerns the

[15] Functional yield refers to the effective performance delivered per unit of material compared to the baseline product, used to determine equivalent substitution ratios

product's active use phase, and from the substitution ratio, which quantifies material equivalence during use.

- Where the recovered product differs from the baseline product in terms of end-of-life treatment, such differences must be reflected in the GHG accounting. This includes variations in disposal method, recyclability, decomposition emissions, or potential for reuse.
- If the recovered product has a more favourable or less favourable end-of-life profile than the baseline, these impacts must be quantified and included in both scenarios to ensure consistency. When direct monitoring is not feasible, reasonable and documented assumptions must be applied based on LCA literature, PCF reports, or regulatory guidance.

4.1.5 EF-data reference approaches

Approach 1: Emission factors retrieved from scientific studies

For the quantification of GHG emissions related to waste management pathways (e.g., landfill, incineration, composting, anaerobic digestion) and virgin raw material substitution, emission factors (EFs) originating from scientific literature can be used. Documented emissions should be supported by emission factors that, where possible, are characterized by lower uncertainties than generic Tier 1 defaults (e.g., IPCC waste model factors). Definitions of Tier 1, 2, and 3 EF are described in Appendix A.1 Tier definitions.

Higher-tier emission factors (Tier 3 > Tier 2 > Tier 1) must be prioritized. If lower-tier EF are used, the project developer must justify why higher-tier options were not feasible

Project developers may extract EF values from scientific studies that are relevant to their waste streams, treatment technologies, and local conditions, and may aggregate them to create Tier 2-type EFs suitable for the project context.

Guidelines for selecting suitable EFs

The project developer must follow the three steps below when selecting emission factors:

1. Alignment with influential factors and practices
    - Emission factors must be selected based on their relevance to the project's waste stream characteristics and treatment pathways, as reported in the referenced studies.
    - Influential factors include: waste composition (biogenic vs. fossil fractions), moisture, treatment technology (e.g., incineration with/without energy recovery, sanitary vs. open landfill, aerobic vs. anaerobic treatment), and local management practices.
    - Where exact alignment between study conditions and project characteristics is not available, project developers may use emission factors derived from studies

that partially align with key parameters. In such cases, a conservative EF value must be chosen, based on documented ranges (e.g., selecting upper-bound methane generation potential for landfill if local DOC is uncertain).

2. Utilization of meta-analyses and synthesis papers
    - Meta-analyses are valuable where data from individual studies are limited or inconsistent, or when a broader evidence base is needed to establish representative values.
    - Meta-analyses must report or assess heterogeneity (I^2). If I^2 is not reported, developers must provide alternative evidence of variability (e.g., range, SD, forest plots) and justify reliability.
    - If high heterogeneity is evident (e.g., $I^2 > 75\%$ or wide spread in results), an uncertainty buffer of 10% must be applied to the EF unless justified via subgroup analysis.
    - Where subgroup results are presented (e.g., by waste type, climate zone, incineration technology), developers must identify the subgroup(s) that apply and select a conservative value from within the relevant range.
    - If multiple meta-analyses qualify, the project developer may average across them, but must report a weighted uncertainty estimate reflecting variability.

Confidence and documentation requirements

- Where a range of EF values is available (e.g., from meta-analysis or multiple studies), the selected EF must be supported at a ≥95% confidence level. This means the chosen value must fall within the range where there is >95% certainty it represents the true emissions under project-relevant conditions.
- The selection process must be transparent and fully documented so that third-party Validation and Verification Bodies (VVBs) can assess the suitability of the chosen EF. This includes:
    - Citing all literature sources considered.
    - Explaining why selected values are relevant and conservative.
    - Documenting the procedure for handling ranges, overlaps, and uncertainties.
    - Providing calculations or extraction methods if data were aggregated.

Approach 2: LCA (or PCF) data

This section defines the evidence requirements for determining the Life Cycle Assessment (LCA)-based emission factors (EFs) of virgin raw materials, recovered waste streams, and final products in both the baseline and project scenarios. It sets acceptable evidence sources, methodological standards, and reporting obligations to ensure that all LCA values are reliable, comparable, and transparently documented.

The requirements are presented in the table below.

Table 3: Emission sources covered under this methodology

Evidence type	Requirements
Source	1. Verified LCA, Environmental Product Declarations (EPDs) or PCFs ○ Must cover the same functional unit and system boundary as required by this methodology (e.g., cradle-to-gate for virgin and recovered products, cradle-to-grave for waste fate). ○ Verification must be by a recognized third-party program operator. ○ For virgin raw materials, EPDs/PCFs must reflect the specific product type that the recovered product displaces. 2. Peer-reviewed and widely accepted LCA databases ○ Examples: ecoinvent, GaBi, national/sector-specific databases. Must be transparent on system boundaries, allocation methods, and geographic scope. ○ Preference must be given to datasets that match the region, technology, and timeframe of the project. ○ For waste fate, project developers must use datasets that distinguish treatment technology (e.g., incineration with/without energy recovery, sanitary vs open landfill). 3. Meta-analyses or industry reference studies by recognized bodies ○ Acceptable sources include publications from international organizations (e.g., IPCC, UNEP, IEA), regional authorities (e.g., EU JRC, US EPA), reputable journals and trade associations. ○ For waste streams, meta-analyses must account for heterogeneity in waste composition and management practices. If heterogeneity is high (e.g., $I^2 > 75\%$), a conservative value or an additional uncertainty buffer must be applied. 4. Peer-reviewed scientific literature ○ Studies must transparently report system boundaries, allocation choices, and influential parameters (e.g., gas capture efficiency for landfill, incinerator energy substitution). ○ If multiple studies are relevant, project developers must either (i) use a conservative value within the range or (ii) average across studies with a weighted uncertainty disclosure. 5. Non-validated LCA data directly provided by suppliers or project participants. Allowable only under the following conditions: ○ The EF must be cross-verified against at least one value from a higher-tier source (preferably for a comparable material, product, or regional waste fate). Any significant deviation must be explained and justified. ○ The underlying methodology must align with ISO 14040/44, ISO 14067, or the GHG Protocol Product Standard, and must disclose system boundaries and allocation rules. ○ The lack of third-party validation must be explicitly disclosed. ○ For waste fate baselines, if only local operator data are available, they must be benchmarked against regional or IPCC default values, with a conservative choice applied where discrepancies exist.

Evidence type	Requirements
Method	• The project developer must clearly present the calculation method used for determining LCAs [16]. Accepted methods include: ○ EN 15804 ○ ISO 14067 (Carbon footprint of products), ○ ISO 14040/14044 (Life cycle assessment principles and requirements), ○ GHG Protocol Product Standard.
Validation body	• The body (if any) that conducted or validated the LCA must be disclosed.
Validation year	• The year in which the LCA was validated must be disclosed. Preferably, the data source should not be older than 15 years.
Baseline and project alignment	• The same data source and methodological standard must be prioritized for both baseline and project emission factors to ensure comparability. If different sources or methods are used, they must be explicitly disclosed with clear explanations of methodological differences and their impact on results. Project developers must: ○ Explain methodological differences (e.g., system boundaries, allocation rules, functional units). ○ Identify EF differences (where/how values differ). ○ Apply a conservative approach to resolve uncertainty.
Uncertainty reporting	• The reported measure of uncertainty (e.g., standard deviation, confidence interval) must be disclosed (if available).
Relevance to the project	• The relevance of the selected LCA/EF must be justified. This includes cross-checking against the actual raw materials replaced, waste streams recovered, and products produced in the project.

Additional provisions for waste streams:

- Where waste stream emission factors are not available in standard databases, developers may use modeled values based on waste management practice scenarios (e.g., incineration, landfill, composting) from authoritative sources such as IPCC Guidelines, EU Waste Framework Directive studies, or regionally specific waste LCAs.
- If waste treatment baselines differ regionally, the project developer must conservative realistic assumptions that reflect local practice.

[16] Spend-based (expenditure-based) methods are not acceptable under this methodology, as they rely on monetary values rather than physical or process data

4.2 GHG emissions

This section outlines how to calculate the GHG emissions associated with both the baseline and project scenarios. Emissions must be quantified for each relevant activity affected by the intervention, using consistent functional units and system boundaries. The following subsections describe the specific sources of emissions to be included and the required methods for calculation.

When calculating recovery emissions, project developers may use one of the following approaches:

- Primary (Tier 3) data which are project specific (e.g., energy use, fuel consumption, process emissions)
- Secondary (Tier 1-2) data (e.g., scientific literature derived values, LCA databases, industry benchmarks) when primary data are not available

Where feasible, material-specific emission factors should be used to reflect the differences in recovery intensity for various materials (e.g., plastics vs. metals vs. composites). These factors may be expressed per tonne of input or per tonne of recovered output, but consistency must be maintained.

4.2.1 Production of raw materials (baseline only)

Emissions must be calculated based on the type and quantity of raw material that would have been used in the absence of the project, using material-specific cradle-to-gate emission factors. These factors should reflect regional or product-specific characteristics where available, or use conservative default values from recognized LCA databases. These emissions are calculated based on the following equation:

$$E_1 = \sum_r (EF_r \cdot Q_r \cdot SR) \quad (1)$$

Where:

E_1	=	Total GHG emissions from production of virgin raw materials (tCO_2e/year)
EF_r	=	Emission factor for the production of raw material r (tCO_2e/tonne)
Q_r	=	Quantity of raw material r that would be used in the baseline (t/year)
SR	=	The substitution ratio (SR) shall be applied as a proportional factor in the calculation of avoided emissions from virgin material displacement. When SR < 1, the emission reductions attributed to the displacement of virgin material must be reduced in direct proportion to the ratio.

Only the fraction of recovered material that demonstrably replaces virgin input can be credited. If functional equivalence is partial, the emission reductions must be adjusted accordingly, as described in section 4.1 Functional equivalence and comparative basis.

4.2.2 Transportation of (raw and/or waste) materials

The emissions are calculated for each material (x) in scope.

- For the raw materials the calculation is based on the distance between their production location and the manufacturing of the corresponding product, and the mode of transportation used (m).
- For the waste materials the calculation is based on the distance between their usage location and their EOL location, and the mode of transportation used (m).

$$E_2 = \sum_c \sum_x (EF_m \cdot Q_{x,c,m} \cdot D_{x,c,m} \cdot SR) \tag{2}$$

Where:

E_2	=	Total GHG emissions of transportation (tCO_2e/year)
EF_m	=	Emission factor of the mode of transportation m (tCO_2e/tonne-km)
$Q_{x,c,m}$	=	Quantity of material x sent to location c via the mode of transportation m (t/year)
$D_{x,c,m}$	=	Distance traveled of material x to location c via the mode of transportation m (km). If the specific location is not known, a conservative average distance can be assumed, provided that it is thoroughly justified in the POD.
SR	=	Substitution ratio (only relevant for the baseline calculation.

Notes:

- Transportation-related emissions must be calculated for both the baseline and project scenarios. However, these emissions are only required to be monitored if the difference between baseline and project transportation is material (as defined by the methodology's materiality threshold).
- Specifically, four categories of transportation emissions are considered:
    - Baseline waste transportation
    - Baseline raw material transportation

  - Project EOL waste transportation
  - Project recovered material transportation
- Emissions shall be calculated from the point of collection up to the relevant destination (e.g., recovery facility, raw material destination, or EOL site).
- If waste is sourced directly from its final EOL location (e.g., landfill), only project transportation emissions are relevant, as baseline transportation has already occurred.
- If waste is sourced directly from its original generation point, both the baseline (counterfactual) and project transportation emissions must be calculated. In such cases, part of the project emissions may be offset by the baseline, potentially canceling out.

4.2.3 Waste recovery process (baseline and/or project)

The waste recovery process refers to the activities required to transform waste materials into a usable product or feedstock, including sorting, cleaning, mechanical or chemical processing, and any other steps necessary to meet the performance and quality criteria of the recovered material.

Emissions from the project-side recovery process must always be accounted for. These represent new activities introduced by the intervention and are a direct source of project emissions.

In contrast, baseline recovery emissions are only relevant when the waste stream was already being diverted to a recovery or recycling pathway before the project. In such cases, the baseline must reflect the emissions from the existing process that is being displaced. If a functioning baseline recovery route exists, a leakage assessment is required, as described in section 1.8 Leakage & permanence. The project intervention must demonstrate that it results in a net reduction in GHG emissions compared to the displaced recovery pathway.

To calculate the waste recovery emissions, the following equation can be used for each material or waste stream:

$$E_3 = \sum_x (EF_{x,rec} \cdot Q_{x,rec}) \tag{3}$$

Where:

E_3	=	Emissions of the waste recovery process (tCO_2e/year)
$EF_{x,rec}$	=	Emission factor for recovering material x (tCO_2e/tonne)
$Q_{x,rec}$	=	Quantity of waste material x processed through the recovery operation (t/year)

If the emission factor used covers the entire mass of processed waste, no further conversion is needed. If it only applies to the recovered fraction (e.g., recycled output), the emission must be scaled accordingly using the recovery yield.

4.2.4 Manufacturing of final product (if affected)

This component accounts for any change in GHG emissions during the manufacturing of the final product resulting from the use of recovered materials. It is only included if the use of the recovered input leads to a measurable change in energy use, process emissions, or other manufacturing-related impacts compared to the baseline material. If there is no significant difference, this component can be excluded, but the assumption must be justified in the Project Overview Document (POD). These emissions are calculated based on the following equation:

$$E_4 = \sum_{mp} (EF_{mp} \cdot Q_x) \qquad (4)$$

Where:

E_4	=	Total GHG emissions from the manufacturing stage (tCO_2e/year)
$EF_{x,m}$	=	Emission factor for manufacturing with material x (tCO_2e/tonne)
Q_x	=	Quantity of product manufactured using material x (t/year)

The emission factors selected should reflect differences in processing requirements between virgin and recovered inputs.

4.2.5 End-of-life treatment of waste

This component accounts for the GHG emissions that would occur from the disposal of the waste materials in the absence of the project. It also includes the EOL emissions from the recovered product.

Project developers must assess the likely end-of-life (EOL) pathways for each relevant waste stream. This includes identifying the share of waste going to landfill, incineration (with or without energy recovery), recycling, or other treatment. Disposal ratios must be based on reliable sources such as industry reports, national statistics, LCA studies, or documented company practices.

Once the EOL mix is established, the GHG emissions must be calculated as the sum of emissions from all relevant waste fates, weighted according to the proportion of waste allocated to each fate. For each pathway, the relevant emission factors or estimation methods should be applied. The IPCC Guidelines for National GHG Inventories – Volume 5: Waste

(Category 5) may be used to calculate emissions from landfill, incineration, and wastewater handling. Project developers are responsible for selecting the appropriate calculation method for each relevant EOL pathway based on the waste type and disposal practice.

Below are indicative approaches for common disposal scenarios:

Incineration without energy recovery (fossil-based content)

Estimate CO_2 emissions from the fossil carbon content of the waste.

$$E_{inc} = Q_{x,inc} \cdot C_x \cdot F_{fossil} \cdot 44/12 \quad (5)$$

Where:

$Q_{x,inc}$	=	Quantity of waste x incinerated (t/year)
C_x	=	Carbon content (tonnes C / tonne waste)
F_{fossil}	=	Fossil share of total carbon
$44/12$	=	Molecular weight ratio for CO_2 from C

Incineration with energy recovery

Subtract avoided fossil fuel emissions from the incineration emissions.

$$E_{net,\,inc} = E_{net,\,inc} - ER_{heat} - ER_{elec} \quad (6)$$

Where:

ER_{heat}	=	Avoided emissions from displaced thermal energy $E_{heat} = Q_{x,inc} \cdot CV_x \cdot EF_{fuel}$
ER_{elec}	=	Avoided emissions from displaced electricity $ER_{elec} = ER_{heat} \cdot EE$
CV_x	=	Calorific value of waste x (MJ/tonne)
$EF\,(fuel)$	=	Emission factor of displaced fossil fuel ($kgCO_2e$/MJ)
EE	=	Energy conversion efficiency to electricity (%)

Other (e.g., open burning, uncontrolled dumping, recycling, etc)
Use simplified IPCC default factors or regional LCA data.

$$E_{other} = Q_{x,other} \cdot EF_{x,other} \tag{7}$$

Where:

$EF_{x,other}$	=	Default emission factor for activity (tCO_2e/tonne)

4.3 Uncertainty

To ensure the credibility and conservativeness of emission reduction estimates, this methodology provides two approaches for addressing uncertainty, depending on the type of project and the tier of data used (see Appendix A: Data selection).

Option 1: Projects with Tier 3 Data

For projects using Tier 3 data, the project developer must conduct a quantitative uncertainty assessment. To do that the tool developed by the GHG Protocol Initiative [17] can be used. This Excel-based tool automates the aggregation steps for developing a basic uncertainty assessment for GHG inventory data, following the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories. The tool is supplemented by a guidance document [18], which describes the functionality of the tool and gives a better understanding of how to prepare, interpret, and utilize uncertainty assessments. This approach allows for more precise project-specific estimates and may support higher claims when uncertainty is well-characterized and transparently reported.

Option 2: Projects with Tier 1 or Tier 2 Data

Projects using Tier 1 or Tier 2 data, a simplified, conservative approach must be followed to ensure robustness of estimates:

- **Conservative Parameter Selection**: Project developers must select values from the conservative end of available ranges. Specifically:
    - EFs reported with a mean and a 95% confidence interval (CI):
        - Project developers must select a value from the conservative end of the CI.
        - The chosen value shall be located 25% of the distance from the mean toward the lower (more conservative) bound of the 95% CI.[19]

[17] https://ghgprotocol.org/calculation-tools-and-guidance
[18] https://ghgprotocol.org/sites/default/files/2023-03/ghg-uncertainty.pdf
[19] Example: If mean EF = 1.0 and 95% CI = [0.8, 1.2], then EF = 1.0 – (0.25 × (1.0 – 0.8)) = 0.95.

    - EFs reported as a single value (no 95% CI or range provided):
        - The reported value must be used directly, provided the source is credible (e.g., IPCC guidelines, national inventory, or peer-reviewed literature).
        - Where multiple single-value EFs are available, the most relevant must be used along with an explanation in the POD.
        - The choice must be justified in the monitoring report.
- **Meta-Analysis Based Factors**: When using meta-analyses to derive emission factors or emission reduction percentages, developers should combine multiple context-specific variables to ensure the selected EF (from the EF ranges) is both conservative and grounded in the most relevant evidence.

This approach provides a practical and reliable framework for uncertainty management in cases where project-specific measurements are not feasible.

5 Net reduction of GHG emissions

The project developer can *estimate* the GHG emissions reduction of the project during the crediting period based on the best available data at the time of the validation of the POD. The issuance of the emission reduction certificates is done on a yearly basis, after updating the project design parameters (see section 6.1 Monitoring), and verifying the GHG emission reduction by a VVB. In other words, the *project emissions* and therefore the *net reduction of GHG emissions* are *dynamic* as they can change from year to year, depending on the actual project details.

The GHG emission reduction is defined as the difference between the baseline emissions and the project emissions [20].

To conservatively account for potential leakage, a (potentially reversible) leakage deduction factor is applied to the total net emission reductions. This factor reflects the assessed risk that the project activity may indirectly cause an increase in GHG emissions outside the project boundary, through market displacement. The applicable leakage deduction is determined based on the classification described in section 1.8 Leakage & permanence.

To calculate the net GHG emissions reduction, the following equation can be used:

$$ER = (BE - PE) \cdot (1 - LP) \tag{8}$$

Where:

ER	=	Net GHG emissions reduction (tCO_2e)
BE	=	Baseline emissions (tCO_2e)
PE	=	Project emissions (tCO_2e)
LP	=	Leakage penalty (%). If leakage is reversible, the credited emissions may be adjusted retroactively, or an equivalent amount may be withdrawn from the buffer pool. In either case, the adjustment equals the leakage penalty multiplied by the annual Net GHG emissions reduction.

[20] The total baseline or project emissions are calculated by summing the emissions from all activities within the defined scope. The activities in scope are determined by the selected project type and the interventions included.

6 Monitoring, reporting, and verification (MRV)

The MRV process is a structured approach to quantifying, tracking, reporting, and verifying greenhouse gas (GHG) emissions and reductions achieved through the recovery of waste products. The goal of the MRV approach is to ensure accurate, consistent, and credible measurement and reporting of emissions over time, enabling the issuance of high-quality environmental attributes.

The monitoring plan includes:

- The type of information that needs to be collected
- The proof for each datapoint
- The frequency of reporting

6.1 Monitoring

For this methodology, the monitoring focuses on collecting three key types of data:

A. **Project Scoping**: Key project details defined before the project start, submitted once during the POD validation phase.

B. **Project Design Parameters**: Variables monitored and reported during each verification cycle to ensure compliance and accuracy. Those must be completed for each specific intervention that is outlined in the project scoping. All parameters for each monitoring period must be listed in the following standardized format: a) Data / parameter: , b) Data unit: , c) Description: , d) Source of data: , e) Measurement procedures (if any): , f) Monitoring frequency: , g) QA/QC procedures: , h) Any comment:

C. **Project Impact**: Outcomes calculated during each verification cycle, based on the monitored project design parameters. Again, the impact must be calculated and presented separately for each intervention in scope.

Table 4: Project scoping

Index	*Name*	*Description*	*Background from this methodology*	*Proof required*	*Frequency of reporting*
A1	Scope of activities	Present list of interventions that are in scope of the project	Section 2.1	N/A	Once during POD validation or update during verification if they change during the crediting period
A2	GHG sources	Explain which GHG sources are in scope of the intervention	Section 2.2	N/A	
A3	Spatial boundary and size	Present lists of facilities and locations where interventions make changes from the baseline scenario.	Section 2.3	N/A	
A4	Temporal boundary (for monitoring)	Present lists of all relevant lifecycle stages	Section 2.4	N/A	
A5	Additionality	Prove the additionality requirements	Section 1.4	See section	

Table 5: Project design parameters

Index	*Category name*	*Subcategory name*	*Description*	*Proof required for baseline*	*Proof required for project*	*Frequency of reporting*
B1.1	4.1 Functional equivalence and comparative basis	-	• If the recovered product has different durability, efficiency, or functional performance that alters use-phase emissions (e.g. energy consumption, maintenance frequency).	• Industry references on typical service life/maintenance of virgin products • Any baseline data on energy usage in operation. • Specific information retrieved from PCF/LCA reports • Use of scientifically based scenarios if direct measurement is not practical	• Field data or test reports on recovered product performance (e.g. expected lifetime, energy draw). • Repair/maintenance records showing whether performance differs significantly • Use of scientifically based scenarios if direct measurement is not practical • Standardized quality assurance testing results and warranty	Reconfirmed or updated for every verification
B2.1	4.2.1 Production of raw materials (baseline only)	-	• Mass/volume and type of virgin materials that would have been used without the recovery intervention. • Associated upstream impacts (e.g., mining, drilling, or other extraction processes).	• Industry/historical data on typical virgin feedstock consumption in the region. • Published LCAs or EF (emission factor) databases (IPCC, GHG Protocol)	• Mass-balance documents proving how much virgin feedstock is actually replaced by the recovered material. • Any supporting data if partial virgin inputs are still used.	
B2.2	4.2.2 Transportation of (raw and/or waste) materials	Distribution Routes	• Distances/modes to deliver each material. • EF by vehicle type (truck, ship, rail), based on the region's energy mix.	• Typical route distances in baseline (mines/ports → factory → end user) • Average emission factors (IPCC, GHG Protocol, local guidelines) • Specific information retrieved from PCF/LCA reports	• Shipping/transport logs/routes for recovered products (f.i. based on fuel receipts, GPS, or third-party confirmations) • Updated or region-specific EFs if the project invests in more efficient transport	

Index	*Category name*	*Subcategory name*	*Description*	*Proof required for baseline*	*Proof required for project*	*Frequency of reporting*
B2.3	4.2.3 Waste recovery process (baseline and/or project)	Waste Type & Quantity	• Identify each waste stream. • Measure total mass/volume diverted. • Initial condition or key performance metrics of the waste/product at collection	• Historic disposal records or stats. • Landfill/incineration logs. • Specific information retrieved from PCF/LCA reports	• Weighbridge tickets, invoices, or audits of actual waste collected/diverted	
		Sorting Efficiency	• Fraction of recovered material vs. residue. • Sorting method (manual/mechanical/other)	• Assumption of minimal/no sorting in baseline • Any partial recovery data if recovery happens before. • Specific information retrieved from PCF/LCA reports	• Facility logs for recovered vs. rejected mass • Process flow diagrams	
		Recovery Energy & Inputs	• Electricity/fuel for shredding, washing, etc. • Any pre-treatment additives. • Emission factors for electricity and fuel used	• Industry/average data for virgin extraction • Default energy consumption. • Specific information retrieved from PCF/LCA reports • Regional grid-mix EF	• Meter readings, fuel bills for actual recovery steps • Equipment specs • Regional grid-mix EF	
B2.4	4.2.4 Manufacturing of final product (if affected)	Material Composition	• Ratio of virgin vs. recovered feedstock. • Any additives or binders required	• Conventional “recipe” or bill of materials for virgin products. • Specific information retrieved from PCF/LCA reports	• Purchase orders or batch sheets detailing recovered vs. virgin inputs • Mass balance documentation	

Index	*Category name*	*Subcategory name*	*Description*	*Proof required for baseline*	*Proof required for project*	*Frequency of reporting*
		Manufacturing Energy	• Electricity/fuel used to process materials (e.g., melting, forming) • Emission factors for electricity and fuel used	• Published LCAs or site-specific energy records for baseline • Specific information retrieved from PCF/LCA reports • Regional grid-mix EF	• Meter or sub-meter data for recovered line • Utility bills/production logs isolating recovered processes • Regional grid-mix EF	
		Yield & Quality	• Final product yield, rejects/rework rates • QA tests, certifications ensuring functional equivalence	• Historical yield data for virgin products (e.g., scrap rates) • QA/QC reports proving performance standards are met • Specific information retrieved from PCF/LCA reports	• Logs showing recovered-content yield vs. rejects • QA/QC reports proving performance standards are met	
B2.5	[4.2.5 End-of-life treatment of waste]()	Residue Disposal	• Disposal: EF for various disposal scenarios • How non-recoverable residues or by-products are handled (landfill, incineration, etc.)	• Local disposal regulations. • Historical disposal logs • Regional electricity mix (for fossil fuel substitution by incineration) • Specific information retrieved from PCF/LCA reports	• Disposal facility receipts, weighbridge tickets • Proof of compliant disposal for non-recoverable residues	
B2.6	[1.8 Leakage & permanence]()	-	Document the evidence that supports the leakage-risk tier (Low 0 %, Medium 5 %, High 10 %)	• Prior fate of waste (e.g., disposal statistics, recycling rates) • Regional supply-demand balance for the waste stream • Historic secondary-market price trends	• Actual sourcing records showing where waste was collected • Market analysis demonstrating no displacement of existing recovery • Third-party confirmations or trade data	At POD submission, then every verification **if anything changes** (minimum once every 4 years)

Table 6: Project impact

Index	*Category name*	*Subcategory name*	*Calculation method*	*Frequency of reporting*
C1	Net reduction of GHG emissions	-	Section 5	Updated every verification

6.2 Reporting

Monitoring reports must include:

- A general description of the project, including the locations where baseline emissions would occur and the project waste recovery is done.
- A description of the data collection process, frequency of monitoring, and procedures for archiving data, as presented in section 6.1 Monitoring
- The roles of individuals involved in monitoring and data collection (e.g., responsibilities)
- The monitoring time period must be documented in every report.
- The frequency of the submission of the monitoring reports is defined based on the direction given in section 2.4 Temporal Boundaries
- All monitoring reports must be accessible on the demand of the *Validation, Verification Bodies* (VVB) for validation and verification procedures.

6.3 Verification

An approved Validation and Verification Body (VVB) must be selected to execute the verification process based on the monitoring plan and reports to confirm that the program's requirements are met, ensuring the accuracy of the calculated GHG reductions. Information regarding the frequency of the verification process can be found in the Proba Standard. No additional requirements for site inspections are prescribed for this methodology. The project developer must define a proper site inspection plan in the POD. Project developers must transparently define a verification plan in collaboration with the VVB to ensure that key variables are accurately represented. This plan must outline how critical claims will be substantiated using independent or verifiable data sources where applicable. The verification approach must be documented in the POD and implemented during the verification period.

References

European Commission. (2020). Categorisation system for the circular economy. Available at: https://circulareconomy.europa.eu/platform/sites/default/files/categorisation_system_for_the_ce.pdf

European Commission. (2021). Recommendation on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations (PEF Method). Official Journal of the European Union, 2021/C 227/01. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021H2279

European Commission – Joint Research Centre (JRC). (2010). ILCD Handbook Series: International Reference Life Cycle Data System (ILCD). Publications Office of the European Union. Available at: https://eplca.jrc.ec.europa.eu/ILCDHandbook.html

Intergovernmental Panel on Climate Change (IPCC). (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5: Waste. Prepared by the National Greenhouse Gas Inventories Programme. Edited by H. S. Eggleston, L. Buendia, K. Miwa, T. Ngara, and K. Tanabe. IGES, Japan. Available at: https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html

Intergovernmental Panel on Climate Change (IPCC). (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5, Chapter 1: Introduction. Available at: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_1_Ch1_Introduction.pdf

Intergovernmental Panel on Climate Change (IPCC). (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Available at: https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

International Organization for Standardization (ISO). (2006). ISO 14040: Environmental management — Life cycle assessment — Principles and framework. Geneva: ISO.

International Organization for Standardization (ISO). (2024). ISO 59004: Circular economy — Vocabulary, principles and guidance for implementation. Geneva: ISO.

Japan Automobile Tyre Manufacturers Association (JATMA). (2024). Tyre $LCCO_2$ Calculation Guidelines, Version 3.0.1 (Full Disclosure Version). See especially page 3 for LCA structure and data principles.

Organisation for Economic Co-operation and Development (OECD). (2016). Extended Producer Responsibility: Updated Guidance for Efficient Waste Management. OECD Publishing, Paris.

Sund, J., Albizzati, P. F., Scheutz, C., & Tonini, D. (2025). Comprehensive assessment of environmental and economic impacts of the entire EU waste management system. Waste Management, 204, Article 114910. https://doi.org/10.1016/j.wasman.2025.114910

World Resources Institute (WRI) & World Business Council for Sustainable Development (WBCSD). (2013). GHG Protocol: Technical guidance for calculating Scope 3 emissions, Category 5 – Waste generated in operations. Available at: https://ghgprotocol.org/scope-3-technical-guidance

World Resources Institute (WRI) & World Business Council for Sustainable Development (WBCSD). (2023). GHG Protocol: Estimating and reporting the comparative emissions impacts of products — Guidelines for attributional and consequential LCA approaches. Available at: https://ghgprotocol.org/product-guidance

Methodology Governance and Review

As this methodology and sector are new to Proba, a re-evaluation of the methodology will be conducted with an independent expert within one year of its issuance.

In the interim, a maximum of 25,000 tCO_2e per project per year will be eligible for issuance. This limit will be reviewed annually to assess whether it remains appropriate.

Appendix A: Data selection

In the context of greenhouse gas (GHG) emissions reporting and inventory management, data and methodologies are categorized into three tiers (Tier 1, Tier 2, and Tier 3), as defined by the Intergovernmental Panel on Climate Change (IPCC). These tiers represent varying levels of accuracy, data specificity, and complexity. Here's a detailed look at each:

Table 7: Tier 1, 2 and 3 explanation

Tier 1	Tier 2	Tier 3
This is the most basic level of calculation which uses default emission factors provided by the IPCC or other authoritative sources. These factors are generally based on a **broad average of data** and are meant for use when more specific data are not available. It is ideal for initial assessments, small-scale projects, or regions where data collection capabilities are limited. It requires the least amount of data and provides estimates that are less precise.	These methodologies are more accurate than Tier 1 and involve **country-specific or region-specific** emission factors. These factors take into account the specific characteristics of fuels or technology used in a particular geographic area. They are used when more detailed, reliable data are available and a greater degree of accuracy is required.	This is the most sophisticated level that uses highly **detailed data and advanced statistical or modeling techniques**. This tier often involves continuous emission measurements and may incorporate real-time data collection. It is appropriate for detailed monitoring and reporting, often used in large industries or for regulatory compliance where precise data tracking is necessary.

When evaluating data sources, the project developer must prioritize them in the following order: Tier 3, Tier 2, and Tier 1. This hierarchy ensures that the most robust and reliable data is used first, minimizing potential uncertainty. More information on the impact of data quality on the Uncertainty Factor can be found in section 5 Net GHG emissions reductions.

Tier 3 sources, as defined by the IPCC, offer the highest level of accuracy and detail, making them the most reliable for greenhouse gas (GHG) emissions reporting and inventory management. Tier 2 sources provide moderate accuracy and detail, serving as a secondary option when Tier 3 data is not available. Tier 1 sources are the least detailed and accurate, used only when higher-tier data cannot be accessed. This prioritization ensures the most precise and credible data for effective GHG emissions management.

Overall, baseline emissions must not be overestimated and project emissions underestimated, to guarantee true impact. When in doubt and if no Tier 3 values are available, lower values should be used for baseline emissions (best in class), and higher values should be used for project emissions.

If available, the Project Developer should use a 3-year average of the available data. When a range of relevant data is available (quantities or emission factors) the most **conservative** should be selected, so that the GHG yield is not overestimated.

Appendix B: CO_2e and Global Warming Potential

CO_2e is a metric used to compare the emissions of various greenhouse gases based on their Global Warming Potential (see GWP definition). It expresses the impact of different gases in terms of the equivalent amount of CO2, facilitating a standardized approach to assessing overall greenhouse gas emissions.

The table below lists the GWP of three key greenhouse gases relative to CO_2:

Table 8: Carbon dioxide equivalents per GHG [21]

Greenhouse Gas	Chemical Formula	Global Warming Potential (GWP)
Carbon Dioxide	CO_2	1
Methane (n-f)	CH_4	29.8
Nitrous Oxide	N_2O	273

As such, the equation for calculating the emissions of a GHG expressed in CO_2e is the following:

$$E_{CO_2e} = E_{GHG} \cdot GWP \tag{9}$$

Where:

E_{CO_2e}	=	Emissions of GHG expressed in CO_2e (t CO_2e/year)
E_{GHG}	=	Emissions of GHG (t GHG/year)
GWP	=	Global warming potential of GHG (t CO_2e/t of GHG)

[21] https://ghgprotocol.org/sites/default/files/2024-08/Global-Warming-Potential-Values%20%28August%202024%29.pdf