Gold Standard for the Global Goals

Climate Security & Sustainable Development

METHODOLOGY

GS4GG PAA M400-10

SDG 13

ANIMAL MANURE MANAGEMENT AND BIOGAS USE FOR THERMAL ENERGY GENERATION

Publication Date: 05/05/2026

Version: 2.0

Next Planned Update: 05/05/2028

SUMMARY

This methodology applies to activities that involve the recovery and utilization of methane from animal manure and other organic wastes that would otherwise decay anaerobically, emitting methane into the atmosphere. It presents an integrated approach for Animal Waste Management Systems (AWMS) and the thermal application of the captured biogas in residential, commercial, and institutional settings.

This methodology is an updated version of the Methodology for Animal Manure Management and Biogas Use for Thermal Energy Generation (V1.1), incorporating Gold Standard for the Global Goals (GS4GG) Paris Agreement alignment requirements.

This methodology shall be used in conjunction with the GHG Emissions Reduction & Sequestration Product Requirements and activities and programmes applying this methodology may be issued with GSVERs.

Key Methodological Components:

- This methodology provides an integrated framework for the capture and destruction of methane from improved animal manure management (AWMS component) and the utilisation of the resulting biogas for domestic, institutional, or commercial thermal energy (Thermal component).
- Baseline manure management emissions are quantified using either IPCC Tier 1 (Method 1) or Tier 2 (Method 2) approaches. Method 2 is mandatory for larger systems where the annual emission reduction exceeds 5 tCO_2e per digester.
- Emission reductions from the thermal component are quantified via either field-based measurements (Kitchen Performance Tests) or direct biogas metering,

ensuring that the effects of stove stacking and rebound are mathematically internalized.

- Technical integrity is maintained through mandatory minimum thermal efficiency thresholds (≥40%) for utilization devices and documented sizing requirements for gas holding capacity to prevent routine venting.
- To increase mitigation ambition over time and align with national decarbonization pathways, baseline emissions are adjusted using a fixed Downward Adjustment Factor (DAF) determined using the GS4GG Methodology Tool 05 - Downward Adjustment Factor Determination.

ACKNOWLEDGEMENTS

This update was developed by Gold Standard with the invaluable guidance of experts and key stakeholders. We would like to specifically acknowledge the contributions of our expert reviewers, including the Methodology Expert Group (MEG) and the Technical Advisory Committee (TAC) members.

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1| KEY INFORMATION

1.1.1 The following table describes the key information for the application of the methodology.

Table 1: Key information

Term	Description
Activity summary	The activity (project/VPA/PoA) involves the installation and operation of anaerobic digesters (biodigesters) to recover methane from animal manure and other organic wastes. The captured biogas is utilised for thermal energy generation displacing the consumption of fossil fuels and/or non-renewable biomass in residential, commercial, industrial, or institutional settings.
Mitigation type	☒ Emission reductions
Applicable activity scale	**Thermal energy:** ☒ Micro scale (e.g., ≤10,000 tCO_2e per year) ☒ Small scale (≤ 180GWh_{th}/yr energy savings) ☒ Large scale (> 180GWh_{th}/yr energy savings) **Methane avoidance:** ☒ Micro scale (e.g., ≤10,000 tCO_2e per year) ☒ Small scale (≤ 60,000 tCO_2e/yr) ☒ Large scale (>60,000 tCO_2e/yr)
Sectoral Scope	3. Energy demand, 13. Waste handling and disposal
Activity Requirement	Community Services
Activity start date	The start date is the date of commissioning (start of operation) of the first biodigester unit under the activity.
Crediting Period start date	The start date of the crediting period is the Activity start date or a maximum of two years prior to the date of Design Certification, whichever occurs later. For phased installation, the crediting period start date is the operations start date of the first digester within the activity boundary. Subsequent units generate emission reductions from their respective operations start dates.
Crediting period length	The maximum crediting period is five years, renewable twice (total of 15 years). The crediting period shall not exceed the technical lifetime of the activity technology unless measures for replacement and maintenance are in place.

Geographical applicability	Global
Limitations	No additional limitations beyond the applicability criteria.

2| DEFINITIONS

2.1.1 In addition to the terms and definitions listed in the Glossary of Gold Standard for the Global Goals, Activity Requirements, and the referenced standards and tools, the following definitions shall apply in the context of this methodology:

Table 2. Terms and definitions

TERM	DEFINITION
Animal manure	Collectively includes both dung and urine (i.e., the solids and the liquids) produced by livestock.
Animal species	Livestock by species e.g., dairy cows, other cattle, buffalo, sheep, goats, camels, llamas, alpacas, deer, horses, rabbits, mules and asses, swine, and poultry. Populations by species can also be further subdivided by category. Category refers to classification inside a species by different relevant attributes such as sex, age or productive purpose in a relevant production system in any given country (e.g., cattle: mature males and females, replacement heifers, calves, etc.).
Animal Waste Management System (AWMS)	The system designed for the handling, storage, treatment, and utilisation of animal manure and the resulting outputs (biogas and digestate).
Clean Thermal Energy Cooking (CTEC)	A universally applied acronym referring to modern, metered energy cooking devices that record fuel or energy use directly, or through a supplementary meter, with the ability to record the amount of energy or fuel used for cooking over time.
Continuous useful energy output	Energy transferred to the contents of a cooking vessel, including the sensible heat that raises the temperature of the contents of the cooking vessel and the latent heat of evaporation of water from the cooking vessel, divided by the time of the operation of the cooking task.
Crediting Baseline	The baseline used for the calculation of emission reductions. It is the result of the baseline setting procedure, determined as the lower value between the Conservative BAU Scenario and the Downward Adjusted Baseline Scenario.
Digestate	The material remaining after the anaerobic digestion of a biodegradable feedstock.

Downward Adjustment Factor (DAF)	A numerical coefficient applied to crediting baselines to ensure the encouragement of ambition by setting crediting baselines below Business-As-Usual (BAU) levels and increasing the ambition of crediting baselines over time. Refer to GS4GG Tool 05: Downward Adjustment Factor Determination (hereafter GS4GG MT 05), for further details on classification and default DAF.
Flaring	Controlled oxidation of biogas in an enclosed or open flare device, resulting in conversion of CH_4 to CO_2 and H_2O
Stove stacking	The use of multiple stoves or cooking devices concurrently or interchangeably by the same end user. Activity beneficiaries continue to use traditional or other stoves alongside the activity device (e.g., biogas stove).
Venting	The intentional or unintentional release of uncombusted biogas to the atmosphere.
Technical life	Average time for which the activity technology (e.g., biodigester, biogas stove) may continue to be operated in a safe manner and with minimal loss of performance. The technical life shall be as per the manufacturer's specification or independent study report. Professional or expert opinion is not accepted as a source for this parameter.
Volatile Solids (VS)	The organic material in livestock manure, consisting of both biodegradable and non-biodegradable fractions.
Wood-to-charcoal conversion factor (WCCF)	A factor expressing the amount of wood required to produce a standard quantity of charcoal. Activity developers shall apply a stratified default approach: • **Sub-Saharan Africa (SSA) or Least Developed Countries (LDCs):** A default ratio of 6:1 (approx. 17% kiln efficiency) shall be applied, reflecting the dominance of traditional earth-mound kilns. • **Industrialized or High-Efficiency Regions:** A conservative default ratio of 4:1 (approx. 25% kiln efficiency) shall be applied. • **Optional conservative application:** Activity developers may apply the conservative default ratio of 4:1 irrespective of the geographic region, including SSA and LDC contexts.

3| SCOPE, APPLICABILITY, AND ENTRY INTO FORCE

3.1 | Scope

3.1.1 This methodology applies to activities that involve the recovery and utilisation of methane from animal manure and other organic wastes[1] that would otherwise decay anaerobically, emitting methane into the atmosphere in the absence of the activity. It also applies to centralised treatment facilities that receive and treat manure from multiple farms within the applicable geographical area

3.1.2 The methodology covers two main components:

a. **Methane Avoidance (AWMS):** The capture and destruction of methane from improved Animal Waste Management Systems (e.g., anaerobic digesters).

b. **Biogas Utilisation:** The use of the captured biogas for thermal applications[2] (e.g., cooking, water heating, lighting, and industrial uses such as boilers, heaters, and dryers) in residential, commercial, industrial, institutional, or small-farm settings.

3.1.3 Co-digestion of manure with other eligible organic waste streams (e.g., agricultural residue, kitchen food waste, the organic fraction of municipal solid waste (MSW), abattoir waste and crop residues) is permitted, provided that these feedstocks do not create double counting with other waste-sector baselines and can be monitored appropriately

3.1.4 The activity may involve progressive installation of biodigesters over the crediting period.

3.2 | Applicability

3.2.1 General Conditions

3.2.2 The methodology applies only to the fraction of the manure that would decay anaerobically in the absence of the activity, as established by a baseline survey. The methodology applies only to livestock manure managed under baseline conditions in systems that result in substantial anaerobic decomposition and methane generation (e.g., anaerobic lagoons, liquid slurry systems, deep pits), consistent with applicable IPCC methane conversion factors. Predominantly aerobic systems, including solid storage or dry heaps

[1] For example, co-digestion of kitchen food waste and the fresh septic tank sludge may be included. However, the methane avoidance claims are only limited to animal waste for simplification purposes.

[2] The methodology does not limit the application of biogas use. The developer may apply approved GS4GG or PACM methodology for uses (thermal or electric applications) of recovered biogas that are not covered under this methodology.

with only incidental anaerobic conditions, are not eligible unless they demonstrably meet the applicable methane generation criteria.

3.2.3 No methane recovery and destruction (by flaring or combustion for gainful use) takes place in the baseline scenario.

3.2.4 Implementation Structure

3.2.4.1 | The activity is implemented by a developer and can include additional activity participants. Individual households and institutions may be represented collectively (e.g., by community organizations) but do not individually act as activity developers.

3.2.5 AWMS Quantification Methods

3.2.5.1 | The methodology offers two methods for quantifying baseline emissions from the AWMS component, based on the Intergovernmental Panel on Climate Change (IPCC) 2019 Guidelines:

a. **AWMS Method 1 (IPCC Tier 1):** Applicable to individual households, small farms, or small institutional settings.

b. **AWMS Method 2 (IPCC Tier 2):** Requires more detailed data on manure characteristics and management systems.

3.2.5.2 | **Mandatory use of Method 2:** If the annual emission reduction from the methane recovery component (AWMS) is higher than five (>5) tonnes of CO_2e per biodigester on an annual average basis across the activity, AWMS Method 2 shall be applied.

3.2.5.3 | Activities may include biodigesters applying both methods, provided they are clearly differentiated into user groups and monitored separately.

3.2.6 Technical and Operational Requirements

3.2.6.1 | **Biogas Utilisation:** The biogas captured shall be utilised. For the purposes of this methodology, captured biogas shall be utilised for thermal energy applications (e.g., cooking, water heating, space heating). Other uses of captured biogas, such as electricity generation or mechanical power, are permitted where quantified under an approved Gold Standard or applicable methodology that covers those uses

3.2.6.2 | **Thermal Device Efficiency:** The rated thermal efficiency[3] of the primary biogas devices (e.g., stoves) or main thermal device displacing fossil fuel or

[3] The efficiency requirement of 40% applies to the primary biogas cook stove or primary thermal device displacing fossil fuel or biomass. Secondary appliances with minor biogas consumption are not subject to this threshold For secondary devices, the minimum acceptable efficiency for Biogas generators (≥25%). Secondary appliances with minor biogas consumption are not subject to these thresholds. Activity developers shall ensure adequate primary air intake and proper biogas-to-air mixing to achieve complete combustion and minimise methane slip. Thermal energy output thresholds are indicative; the focus is on combustion efficiency rather than absolute thermal output.

biomass, determined via standardised laboratory testing (e.g., WBT or ISO 19867-1), shall be at least 40%.

3.2.6.3 | **Thermal Application Limits:** For thermal applications credited under this methodology, the continuous useful energy output shall be less than 150kW thermal per unit.

3.2.6.4 | **Gas Holding Capacity:** The gas holding capacity of the biodigester shall have shall have a capacity[4] that exceeds 50% of the daily maximum gas production, ensuring at least a 12-hour storage. A justification to demonstrate compliance with this requirement pertaining to the biogas digester size shall be included in the PDD.

3.2.6.5 | **Specific Requirements for AWMS Method 2:** The following conditions apply only when AWMS Method 2 is used:

a. The livestock population is managed fully or partly under confined conditions.
b. The annual average temperature of the manure management site is higher than 5°C.
c. In the case of anaerobic lagoons treatment systems, the depth of lagoons in the baseline scenario should be at least 1 metre.
d. Where the baseline system is an uncovered anaerobic lagoon, the retention time shall be at least twelve (12) months, consistent with the specifications in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10, Table 10.17, footnote 7
e. In the activity scenario, the storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester.

3.2.7 Digestate Management and Leakage Mitigation

3.2.7.1 | To mitigate significant leakage risks (See Section 9.1.2), the activity shall implement and monitor appropriate handling practices for the digestate.

a. The digestate shall be handled aerobically (e.g., through prompt soil application, active composting, or drying) to minimise methane (CH_4) emissions. N_2O emissions from the aerobic handling of digestate shall be estimated using IPCC-aligned emission factors. In the absence of activity-specific measurements, a default emission factor of 0.5% of total nitrogen shall be applied for aerobic storage or composting of digestate, and 1% of nitrogen applied for land application, consistent with IPCC 2006 Guidelines and the 2019 Refinement.

[4] Sufficiently large is defined as the capacity that exceeds 50% of the daily maximum gas production, ensuring a 12-hour storage. Compliance may be demonstrated through practical evidence such as manufacturer specifications, standard design documentation, installation verification reports, or monitoring records of typical gas use.

b. Manure or digestate shall not be discharged into natural water resources. Where digestate is transferred to third parties and the activity developer does not control the final application site, the activity boundary shall include digestate storage and handling under activity control. Emissions from downstream land application may be accounted for using conservative default factors, where applicable.

3.2.7.2 | The Monitoring Plan shall detail the procedures for verifying the consistent application of these Best Management Practices (BMPs). The two requirements listed above (aerobic handling and non-discharge into natural water bodies) constitute the full set of Best Management Practices. Verification shall rely on practical, observable evidence such as site inspections and reviews of operational procedures; laboratory testing to demonstrate aerobic conditions is not required. Failure to verify BMPs will result in the application of mandatory conservative leakage deductions (See Section 9.4.3, Tier 2).

3.2.8 Technical life and Replacement

3.2.8.1 | If the expected technical life of the activity technology (biodigester or thermal device) is shorter than the crediting period, the activity developer shall describe measures to ensure replacement or retrofitting with comparable or better technology performing the same AWMS function. If this cannot be demonstrated, no emission reductions can be claimed after the technical life has ended. This shall be achieved by either:

a. Replacing the unit with comparable or better technology; or

b. Retrofitting essential parts with a performance guarantee. For new units, essential system components shall be covered by a manufacturer warranty or performance guarantee. For replacements or retrofits of essential components during the crediting period, the activity developer shall ensure that components meet the original technical specifications and are supported by an appropriate warranty or supplier assurance. Minor spare parts that do not materially affect system performance are excluded.

3.2.8.2 | If neither of the prior conditions can be demonstrated and implemented, no emission reductions can be claimed for the technology after its technical life has ended.

3.2.8.3 | Emission reductions may be claimed for retrofitted/repaired devices during an extended lifetime only if the details of the retrofits/repairs are documented and the extended lifetime is demonstrated through a warranty, guarantee, or standardised durability test.

3.2.9 Avoidance of Double Counting

3.2.9.1 | To avoid double-counting or double claiming, the activity developer shall:

a. Explain the proposed method for installation of all activity units (biodigesters and thermal devices) in the PDD/VPA-DD; and

b. Ensure all activity units (biodigesters and thermal devices) are identified with a unique physical identifier or a robust digital identifier and tracked in the activity database. Where thermal devices are directly and exclusively connected to a single biodigester, they may be tracked under the biodigester's unique identifier, provided that the activity database ensures clear one-to-one linkage and prevents double counting;

c. Clearly communicate its ownership rights and intention of claiming the emission reductions by contract or clear written assertions in the transaction paperwork to all other activity participants, technology manufacturers, and retailers. Minor tier-2 component suppliers or spare part manufacturers are exempt from this requirement;

d. Obtain and document Informed Consent from the end-users. Transaction records shall contain a verified assertion in an accessible local language that the user was informed of the carbon title waiver, and that the end-users acknowledge that the emission reductions generated from use of activity biogas units are claimed exclusively under the registered activity and shall not be claimed independently by end-users.

e. Exclude from the activity any biogas unit included in any other voluntary market, PACM, or CDM project/PoA.

3.2.9.2 | **Safe Water Supply (SWS) Overlap:** When a biodigester and a safe water supply (SWS) intervention (such as water purification that eliminates the need for boiling) overlap in the same area or households, the activity design shall include measures to prevent double-counting of emission reductions**.**

a. To ensure accuracy, if the SWS activity is implemented, it shall calculate its baseline fuel consumption for water boiling as per applied methodology assuming the use of the activity devices (e.g., biogas stoves) deployed by this activity, along with traditional stoves, if applicable.

b. Activities shall employ household-level tagging or registry systems, and the VVB shall conduct a duplication check to confirm that no emission reductions are claimed twice. To ensure compliance with data privacy regulations, activity developers may utilise GDPR-compliant data-sharing alternatives (e.g., anonymised third-party registry checks) to verify non-duplication across different activity developers.

3.2.10 **Overlap with Jurisdictional REDD+ Programs:**

3.2.10.1 | Where the baseline fuel displaced by the biogas is woody biomass, and the activity boundary overlaps with an implemented Jurisdictional REDD+ (J-REDD+) programme or a similar national or sub-national scheme for forestry, the activity developer shall demonstrate that the emission reductions are not subject to double issuance risk.

a. Overlap risk shall be considered immaterial unless the Host Country's Jurisdictional REDD+ FREL/FRL baseline explicitly incorporates and qualifies subsistence household fuelwood consumption as a quantified driver of deforestation. The activity developer shall submit a Declaration of Non-Overlap, which the VVB shall verify against publicly available J-REDD+ registry documents or a formal statement/Nesting Agreement from the relevant authority (e.g., national, sub-national, or regional programme administrator). Absent explicit qualification of subsistence fuelwood in the J-REDD+ baseline, the emission sources are considered distinct, and no further action shall be required.

b. If a direct conflict exists, the activity developer shall demonstrate that the activity specific reductions are not subject to double issuance risk by providing valid documentation for one of the following options:

   i. **Option 1**: Accounting Exclusion: Documentation demonstrating that the jurisdictional program's Forest Reference Emission Level, Forest Reference Level, or accounting methodology explicitly excludes the specific emission sources (e.g., degradation from woodfuel harvesting) or activity classes (e.g., clean cooking/thermal energy) addressed by the activity; OR

   ii. **Option 2:** Attribution Agreement: A formal statement, or Letter of No Objection from the relevant authority (e.g., National, sub-national or authorized authorised program administrator) confirming that the specific emission reductions generated by the activity are attributed to the activity and will be deducted from (or not claimed by) the jurisdictional program to prevent double issuance.

3.2.11 **Venting and Physical leakage:**

3.2.11.1 | Routine venting is not permitted. Emergency venting[5] for safety shall be minimised, recorded and accounted for in activity emissions, where applicable. In order to mitigate risks for physical leakage and venting, activity developer shall provide documentation in the activity design document (PDD) which:

a. Ensures that biodigesters are appropriately designed in terms of their sizing, considering manure inputs and the thermal energy requirements of end-users;

[5] Where direct quantification of emergency venting events is not feasible due to the limitations of low-pressure gas flow meters in micro- and small-scale household systems, the activity developer may apply a conservative default parameter to account for venting.

b. Ensures that the construction or installation of biodigesters complies with relevant national standards and that a quality assurance/quality control (QA/QC) system is put in place for the construction or installation;

c. Ensures that trainings are conducted for all users of biodigesters prior to their commissioning or installation and that the trainings are documented in a verifiable manner (e.g. protocol of trainings, documentation of on-site visits); and

d. Ensures that a plan for periodic inspection and maintenance is in place and rehabilitation services are available throughout the crediting period.

3.2.11.2 | Description of such technical support system shall be provided in the PDD and verified by the VVB during verification. If rehabilitation is undertaken, the details (e.g. parts replaced, specifications followed, personnel conducting the repairs and date of retrofitting) on each biogas digester, methane recovery and combustion system shall be documented.

3.2.12 Indoor Air Pollution (IAP) and Safety

3.2.12.1 | Adequate evidence, such as published literature, manufacturer specifications, laboratory test results, certification reports, or other credible technical documentation, shall be supplied to demonstrate that indoor air pollution (IAP) levels are not worsened compared to the baseline. This serves as a one-time safeguard demonstration at validation rather than an annual MRV requirement, unless the technology or usage conditions change materially.

a. Furthermore, for activities where the activity moves from outdoor to indoor or where the activity technology reduces ventilation IAP levels, (including PM 2.5 and carbon monoxide (CO) emissions), shall not worsen in the activity compared to the baseline. Standard ISO laboratory test reports (e.g., ISO 19867-1 emissions tiers) are sufficient to satisfy this requirement; bespoke field emissions monitoring is not required unless the activity transitions users to a totally unventilated technology.

b. The activity developer shall demonstrate that the devices are designed, constructed, and operated according to the requirements of relevant national or international safety standards or recognised guidelines.

3.2.12.2 | To make claims on SDG 3.9.1 contributions, the activity developer may apply the Gold Standard Methodology to Estimate and Verify ADALYS from Clean Household Air

3.3 | Mandatory Compliance and Safeguards

3.3.1 **GS4GG Requirements:** The activity shall adhere to the GS4GG Principles And Requirements, Safeguarding Principles and Requirements, and the Community Services Activity Requirements.

3.3.2 **Regulatory Compliance:** The activity shall not undermine or conflict with any national, sub-national, or local regulations or guidance for thermal energy supply, devices, or fuel/energy supply/use. The activity shall document the relevant regulatory framework within the activity boundary

3.3.3 **Health and Safety:** Activities shall comply with health and safety requirements at both the organisation (activity developer and implementing partners) level and for end-users, in line with Principle 3 of the Safeguarding Principles and Requirements. Additional safety measures may include safe sitting and anchoring of digesters, flame arrestors/back-flow protection where applicable, user O&M and emergency training, and posting of safety information at the household/institution.

3.3.4 **Contractual Obligation:** The activity developer shall, by means of direct ownership, contractual agreement, or other such arrangement, establish access to the required monitoring data (including metered data streams) and supporting documentation set forth in this methodology and relevant GS4GG standards.

3.4 | Entry into force

3.4.1 The date of entry into force is 90 days from the publication date of this methodology.

4| NORMATIVE REFERENCES

4.1.1 The following standards, tools, and guidelines are normative references for the application of this methodology. Activity developers shall apply the latest valid version of these documents.

4.1.2 References to CDM tools are valid until equivalent tools are published under Gold Standard (GS4GG) or the Article 6.4 Mechanism (A6.4)/Paris Agreement Crediting Mechanism (PACM).

4.1.2.1 | GS4GG Standards and Requirements

a. GS4GG Principles and Requirements
b. Safeguarding Principles and Requirements
c. Community Services Activity Requirements

4.1.2.2 | GS4GG Methodologies, Standards, and Tools

a. Methodology Standard: Requirements for Additionality Demonstration
b. Methodology Standard: Requirements for Methodology Development

c. Methodology Standard: Requirements for Baseline Determination in Methodologies

d. Tool 1 – Emissions from fossil fuel consumption

e. Tool 05: Downward Adjustment Factor Determination

f. Tool 06 – Common Practice Analysis

g. Tool - Analysis of lock-in risk [Latest Approved Version]

h. Tool - Technical lifetime [Latest Approved Version]

i. Requirements and Guidelines: Cookstove Usage Rate Guidelines

j. Tool 07 - Digital Stove Monitoring, Analysis and Reporting Tool (D-SMART)

4.1.2.3 | UNFCCC/A6.4 Tools and Standards:

a. CDM TOOL 14: Project and leakage emissions from anaerobic digesters.

b. A6.4-AMT-002: Investment analysis

c. CDM TOOL 33: Default values for the fraction of non-renewable biomass (or other approved standardized approaches for fNRB determination, such as MoFuSS).

d. A6.4 MEP012-A04: Methodological tool: Fraction of non-renewable biomass [Latest Approved Version]

e. CDM Standard: Sampling and surveys for CDM project activities and programme of activities (or equivalent A6.4/PACM standard).

f. A6.4-AMT-007: Emissions from electricity generation and consumption.

4.1.2.4 | Other Sources:

a. ISO 19867-1: Clean cookstoves and clean cooking solutions -- Harmonized laboratory test protocols

b. Kitchen Performance Test (KPT) Protocol (Latest recognized version, e.g., Clean Cooking Alliance protocol).

c. Water Boiling Test (WBT) Protocol (Latest recognized version). WBT Protocol (Latest recognized version) – Applicable only where explicitly mandated by national standards.

d. IPCC. (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10: Emissions from Livestock and Manure Management.

5| ACTIVITY BOUNDARY AND GHGS SOURCES/SINKS

5.1 | Activity boundary

5.1.1 The activity boundary encompasses all anthropogenic sources of GHGs that are under the control of the activity developer, are related to the activity, or are significantly affected by the activity.

5.1.2 The activity developer shall clearly identify the activity boundary, target area, and associated fuel/feedstock areas.

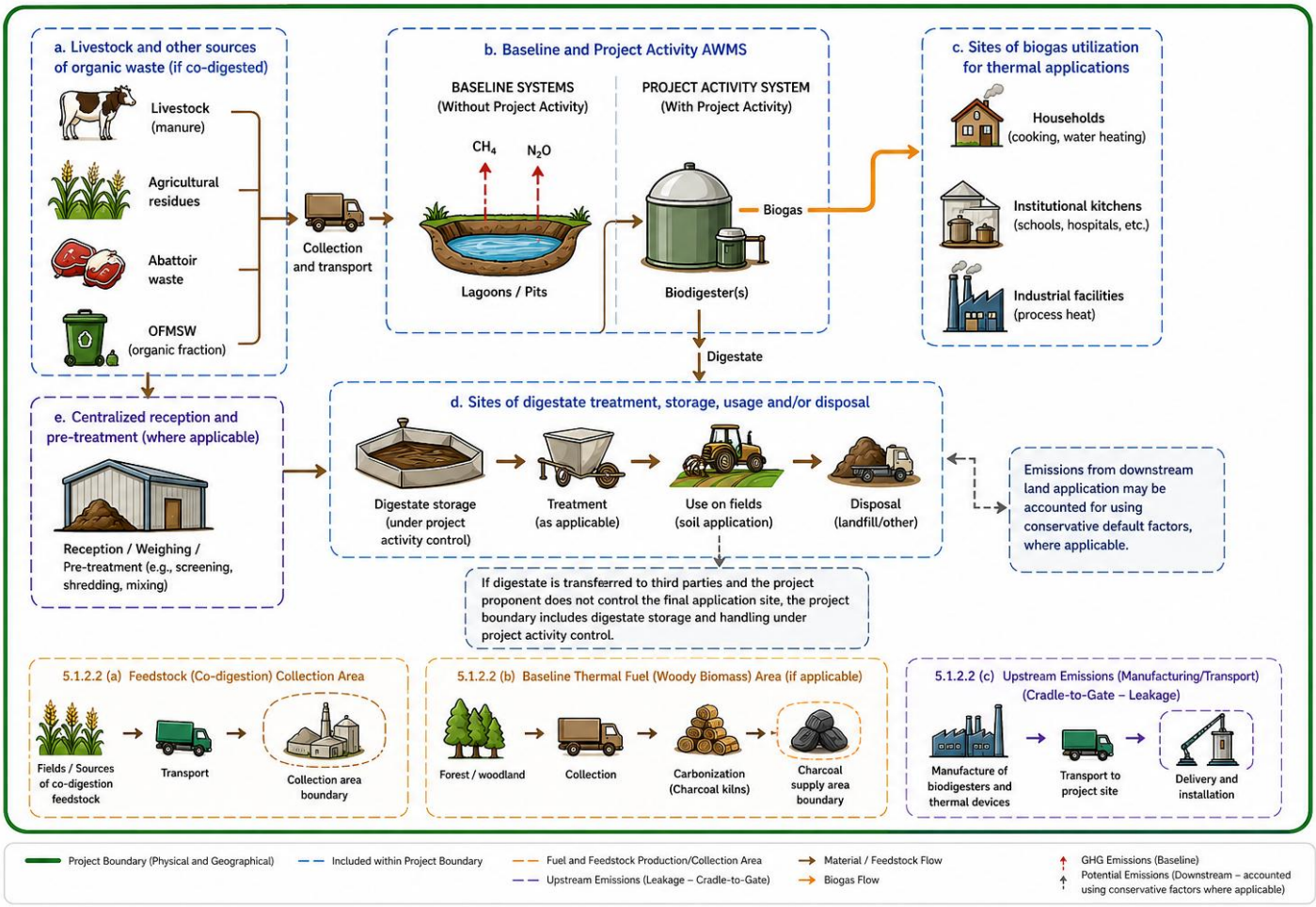

Figure 1: Activity Boundary

5.1.2.1 | **Physical and Geographical Boundary:** The spatial extent of the activity boundary is the physical, geographical site(s) of:

a. The livestock and the locations of other sources of organic waste (if co-digested).

b. The baseline and activity AWMS (e.g., baseline lagoons/pits, activity biodigesters).

c. The sites of biogas utilisation for thermal applications (e.g., households, institutional kitchens, industrial facilities).

d. The sites of digestate treatment, storage, usage (e.g., fields for soil application), and/or disposal. Where digestate is transferred to third parties and the activity developer does not control the final application site, the activity boundary shall include digestate storage and handling under activity control. Emissions from downstream land application may be accounted for using conservative default factors, where applicable.

e. Where applicable, centralised reception and pre-treatment areas for manure collected from multiple locations.

5.1.2.2 | **Fuel and Feedstock Production/Collection Area:** The boundary includes the systems associated with energy and material:

a. **Feedstock (Co-digestion):** In cases where the activity involves co-digestion of other organic materials (e.g., agricultural residues, the organic fraction of municipal solid waste, abattoir waste), the boundary includes the area within which this biomass is collected.

b. **Baseline Thermal Fuel:** Where the baseline fuel displaced by the biogas is woody biomass (including charcoal), the boundary includes the area within which this woody biomass is grown and collected, as well as the facilities where the wood is carbonized (e.g., charcoal kilns).

c. **Upstream Emissions (Manufacturing/Transport):** The upstream emissions associated with the manufacture and transport of the inputs (biodigesters and thermal devices) attributable to the activity (cradle-to-gate) shall be accounted for as Leakage (See Section 9|).

5.1.3 **Target Area:** The target area is the region(s) e.g., village(s) or district(s) where the considered baseline scenario(s) (for both AWMS practices and thermal energy use) are homogenous.

5.1.4 Where baseline conditions differ across the activity boundary, the activity developer shall define separate target areas, each representing a homogeneous set of baseline conditions. Baseline parameters shall be determined for each target area accordingly.

5.2 | GHG Sources

5.2.1 Emissions can occur during fuel production, energy generation, transport, and consumption (delivery of thermal energy). The following sections identify the relevant GHG sources for the baseline scenario, the activity scenario, and leakage.

5.2.2 **Materiality and Simplification Rules**

5.2.2.1 | **Baseline Simplification (AWMS Method 1):** Baseline N_2O emissions from AWMS may be omitted under Method 1 (Tier 1) for simplification, provided this results in a conservative estimate.

5.2.3 **Baseline Simplification (Thermal):** Baseline emissions of CH_4 and N_2O for the thermal component may be omitted if conservative (i.e., total baseline emissions are not overestimated).

5.2.3.1 | **Activity Emission Completeness:** All activity emissions shall be accounted for unless demonstrably negligible.

5.2.3.2 | **Transportation Emissions:** Activity emissions from the transportation of input manure, feedstock and/or digestate shall be accounted for if the total transportation distance exceeds 200 km, or if required under the specific calculation procedures of AWMS Method 2 (Tier 2). To ensure symmetrical accounting, if baseline fuel transportation emissions are included, activity transportation emissions shall also be included, regardless of distance.

5.2.3.3 | **Device Manufacturing/Transport (Embodied Emissions):** Mandatory Inclusion. Indirect GHG emissions (cradle-to-gate) shall be accounted for as Leakage Emissions (Section 9.2 |).

5.3 | Baseline Emissions

5.3.1 The following table details the GHGs included in, or excluded from, the baseline scenario(s).

Table 3. GHGs included in, or excluded from, the activity

SOURCE	DESCRIPTION	GAS	INCLUDED?	JUSTIFICATION
AWMS Component				
Animal Waste Management	Anaerobic decomposition of manure in the baseline system (e.g., pits, lagoons).	CO_2	NO	Biogenic CO_2 emissions from decomposition are excluded.
		CH_4	Yes	Major source of emissions from anaerobic decay.
		N_2O	Yes	Direct and indirect N_2O emissions. Included in Method 2. May be omitted if conservative in Method 1 (See 5.2.2).
Thermal Application Component				
Delivery of thermal energy	Combustion of baseline fuel (e.g., fNRB, fossil fuels) for thermal applications.	CO_2	Yes	Major source. Only CO_2 from the non-renewable fraction of biomass (fNRB) or from fossil fuels is included.
		CH_4	Yes	Important sources from incomplete combustion.
		N_2O	Yes	Important sources from incomplete combustion.

Production and transport of fuel	Emissions associated with production and transport of the baseline thermal fuel.	CO_2e	Yes	Important lifecycle emissions. Included via Upstream Emission Factors (e.g., Wood-to-Charcoal Conversion Factors).

5.4 | Activity emissions

5.4.1 The following table details the GHGs included in, or excluded from, the activity scenario(s).

Table 4. Sources of Activity Emissions

SOURCE	DESCRIPTION	GAS	INCLUDED?	JUSTIFICATION
AWMS Component				
Physical Leakage (Fugitive Emissions)	Emissions from the biodigester system (production, collection, transport of biogas, including emergency venting).	CH_4	Yes	Accounted for via standardised defaults or measurement (CDM TOOL 14).
Pre-Digestion Storage	Emissions from storage of manure before feeding into the digester.	CH_4	Yes	Included if applicable under Method 2 criteria (storage time/dry matter content).
Operational Energy Use	Consumption of fossil fuels or electricity for the operation of the AWMS (e.g., pumps, mixers).	CO_2e	Yes	Shall be accounted for if applicable (GS TOOL 01 / A6.4-AMT-007).
Incremental Transport	Emissions from incremental transportation of input manure and digestate, feedstock, and digestate.	CO_2e	Yes	Included if distance >200km or required by Method 2.
Thermal Application Component				

Delivery of thermal energy (Biogas)	Combustion of biogas in the activity thermal devices.	CO_2	No	Biogas combustion is considered biogenic CO_2.
		CH_4	Yes	Emissions from incomplete combustion of biogas.
		N_2O	No	May be excluded for simplification
Delivery of thermal energy (Stacking)	Continued use of baseline fuels in parallel with biogas ("stove stacking").	CO_2e	Yes	Internalised in Activity Emissions if Thermal Method 1 (KPT) is used.

5.5 | Leakage emissions

5.5.1 Leakage is the net change of GHG emissions occurring outside the activity boundary, attributable to the activity. The following table details the potential sources of leakage emissions that shall be assessed.

Table 5. Sources of Leakage Emissions

SOURCE	DESCRIPTION	GAS	INCLUDED?	JUSTIFICATION
Cross-Boundary Effects (Negative Leakage)				
Embodied Emissions (Upstream)	Cradle-to-gate emissions associated with the manufacturing and transport of the biodigesters and thermal devices.	CO_{2e}	Yes	Mandatory Inclusion. Accounted for using conservative defaults or approved activity-specific LCAs (Section 9.3 |).
Resource Competition (Feedstock)	Diversion of co-digested organic feedstock from competing uses, causing substitution effects (e.g., increased synthetic fertilizer use).	CO_{2e}	Yes	Potential significant source. Assessed based on whether the feedstock is genuine "waste" (Section 9.4.2).
Downstream Environmental Releases (Digestate)	Emissions from the storage and handling of digestate if managed anaerobically or improperly.	CH_4, N_2O	Yes	Potential source of leakage. Assessed via monitoring or default factor (Section 9|).

Thermal Market Effects	Leakage related to the thermal application component (e.g., reuse of displaced baseline stoves outside the boundary).	CO_{2e}	Yes	Assessed via monitoring or default factor (Section 9.4.5).
Cross-Boundary Effects (Positive Leakage)				
Fertilizer Substitution	Displacement of synthetic fertilizers through the proper utilization of digestate.	CO_2e	Yes (Positive)	Potential source of positive leakage. May be quantified and netted against negative leakage (Section 9.4.4).

6| DEMONSTRATION OF ADDITIONALITY

6.1 | Requirements

6.1.1 The activity developer shall demonstrate that the activity would not have occurred in the absence of the incentives provided by the carbon revenues. The demonstration of additionality shall be conducted in accordance with the latest version of the *GS4GG Standard:* Requirements for Additionality Demonstration. The performance-based analysis pathway is not an eligible option under this methodology.

6.2 | Additionality Approach Selection

6.2.1 The activity developer shall demonstrate additionality by conforming to the requirements of one of the options below:

a. **Positive List (Deemed Additionality):** The activity is deemed additional if it meets the geographic, scale, and policy criteria established in RECH Annex 4. This methodology-level analysis is valid for a period of five (5) years from the date of publication, justified by the multi-year update cycles of the underlying international surveys and academic data.
b. **Activity-Specific Assessment:** If the activity does not qualify for a Positive List of RECH Annex 4 (e.g., large-scale activities, or activities operating in urban centers of middle-income countries), additionality shall be demonstrated through a detailed activity specific assessment as described in this section.

6.2.2 **Mandatory Analyses:** All activities, regardless of the approach selected (Positive List or Activity-Specific Assessment), shall successfully complete the following mandatory analyses: i. Regulatory Surplus Analysis (Section 6.3 |);

ii. Lock-In Risk Analysis (Section 6.4 |); and iii. Common Practice Analysis (Section 6.7 |).

6.2.3 If the Activity-Specific Assessment pathway is used (i.e., the Positive List is not applied), the activity developer shall also complete the Investment Analysis (Section 6.5 |) and/or Barrier Analysis (Section 6.6 |).

6.3 | Regulatory Surplus Analysis

6.3.1 The activity developer shall demonstrate that the emission reductions achieved by the activity are regulatory surplus**.** This means the activity and its resulting emission reductions are not required by any existing laws, regulations, or mandates (legal requirements), obligations within the host country's jurisdiction, where such obligations are operationalised through binding instruments.

6.3.2 **Exemptions:** The activity developer may submit credible, authoritative, and up-to-date evidence demonstrating that the de facto market conditions involve systemic non-compliance with the regulation (e.g., widespread continuation of baseline manure management practices despite formal restrictions), or that a government scheme lacks the operational funding, institutional capacity, or enforcement mechanisms to achieve its targets. Note: For high-income countries, all legal requirements shall be deemed to be fully enforced, and this de facto non-enforcement exemption shall not apply.

6.3.3 The analysis shall verify that legal requirements do not:

a. Directly mandate the implementation of the mitigation activity;

b. Indirectly mandate the implementation of the mitigation activity by requiring a certain technological, performance, or management action, or by preventing alternative scenarios; or

c. Establish a support scheme (e.g., subsidy programme) designed to achieve a quantitative target for the relevant technologies that would likely result in the same amount of emission reductions if the activity were not implemented.

6.3.4 The assessment shall be conducted at the start of the 1st crediting period and reassessed at each renewal of the crediting period.

6.3.5 **Host Country Eligibility (Article 6 Negative List Assessment):** The activity developer shall demonstrate that the mitigation activity type is not excluded by the Host Country from participating in carbon market mechanisms. The activity developer shall verify that the activity technology or measure is not included in any publicly available negative list or regulatory exclusion issued by the Host Country.

6.3.6 **Demonstration of Compliance:** Compliance with this requirement shall be demonstrated through one of the following, as applicable, at the time of Validation (including PAA-Alignment Design Change validation for existing activities) and Crediting Period Renewal:

6.3.6.1 | **Official List Review:** A citation of the Host Country's most recent official Article 6 policy framework, decrees, or public eligibility lists (e.g., a "Negative List" or "Ineligible Activity List") published by the Designated National Authority (DNA) or Article 6 Focal Point, confirming the activity is not excluded.

6.3.6.2 | **Explicit Authorisation:** Provision of a Letter of Authorization (LoA) or No Objection from the Host Country's DNA that explicitly authorises the mitigation activity type or sector.

6.3.6.3 | **Confirmation of No Exclusion (Default):** In the absence of a published negative list, positive list, or specific regulatory exclusion, the activity developer shall provide a formal declaration confirming that no official communication or regulation has been issued by the Host Country identifying the specific technology as ineligible for carbon crediting.

6.4 | Lock-In Risk Analysis

6.4.1 The activity developer shall assess the risk that the activity may lead to a lock-in of GHG emissions, technologies, or carbon-intensive practices inconsistent with the achievement of the host Party's NDC or the long-term goals of the Paris Agreement.

6.4.2 **Assessment Framework and Exemption:** The assessment follows the framework established in the GS4GG Standard: Requirements for Additionality Demonstration:

a. For decentralised thermal energy technologies where the technical or operational lifetime is demonstrably less than 10 years, it may be assumed that no significant lock-in risk exists, provided the activity aligns with the host country's sustainable energy strategies.

b. **2030 Sunset Clause:** The validity of the 10-year exemption is limited to 31 December 2030.

c. **Full Assessment:** Technologies with lifetimes exceeding 10 years, or those assessed after the sunset clause, shall undergo a full assessment (See 6.4.4).

6.4.3 **Methodology-Level Determinations and Exemption Conditions:** Based on the assessment framework in the GS4GG Standard: Requirements for Additionality Demonstration and analysis of technology:

6.4.3.1 | **Full Exemption (Net-Zero Compatible Technologies):** Anaerobic digestion systems typically have technical lifespans exceeding the 10-year exemption threshold. However, these systems utilise organic waste streams (avoiding methane emissions) to produce renewable energy (biogas), displacing high-emission baseline practices. Therefore, they pass the Full Assessment criteria as technologies fully compatible with sustainable waste management and renewable energy pathways required for achieving Net-Zero.

6.4.3.2 | **Conclusion:** Activities applying this methodology are fully exempt from further activity-level lock-in risk assessment.

6.4.4 **Requirements for Full Lock-In Risk Assessment**

6.4.4.1 | If the technology deployed does not meet the criteria for Full or Conditional Exemption listed in Section 6.4.3 (e.g., Biogas digestor with a lifetime >10 years, large-scale industrial/institutional thermal applications using supplemental fossil fuels with a lifetime ≥10 years), the activity developer shall conduct a Full Lock-In Risk Assessment following the GS4GG Methodology Tool – Lock in Risk Analysis.

6.5 | Investment Analysis

6.5.1 If the Activity-Specific Assessment pathway is used, the developer shall demonstrate that the mitigation activity is not financially viable without carbon revenue (Investment Analysis) OR that implementation is prevented by significant barriers (Barrier Analysis).

6.5.2 **Selection of Analysis Type:** The appropriate analysis type depends on the scale and context of the activity:

6.5.2.1 | **Investment Analysis:** Shall be used for Large-scale activities or activities implemented in large commercial/institutional livestock farms where standard financial appraisal is the norm.

6.5.2.2 | **Barrier Analysis:** May be used for Micro-scale and Small-scale activities implemented at individual households or small farms where non-financial barriers are the primary deterrent.

6.5.3 **Requirements for Investment Analysis:** If Investment Analysis is selected, the activity developer shall conduct a Simple Cost Analysis, Benchmark Analysis, or Investment Comparison Analysis in conformity with the requirements of the A6.4-AMT-002: Investment analysis. The analysis shall demonstrate that:

a. The activity is not financially viable (e.g., fails to meet the required benchmark or is less attractive than alternatives) without carbon credit revenues; and

b. With carbon credit revenues, the activity becomes financially viable or the most attractive option.

6.6 | Barrier Analysis (optional alternative)

6.6.1 For Micro-scale and Small-scale activities, a Barrier Analysis may be used to demonstrate that significant barriers (e.g., high upfront costs, lack of technical expertise for maintenance, institutional barriers) would prevent implementation without carbon finance. At least one barrier shall be substantiated with verifiable evidence.

6.7 | Common Practice Analysis:

6.7.1 All activities shall evaluate common practice by assessing the market penetration of equivalent technologies in the applicable geographic area (AGA) in accordance with the GS4GG Methodology Tool: Common Practice Analysis.

6.7.2 Activity developers shall apply the following definitions and mandatory parameters:

a. **Assessment Approach and Indicator (P):** The Stock-Based Approach (assessing cumulative diffusion) shall be applied using a Count-based indicator (number of households/facilities). The number of households or facilities (End Users) utilizing the technology.

b. **Data Vintage:** Data utilized shall be the most recent authoritative data available and shall not be older than five years prior to the submission of the PDD for Validation.

c. **Applicable Geographical Area (AGA):** The Host Country. Sub-national or district-level AGA assessment (e.g., defining the boundary at the district or similar administrative level) is permissible if justified by distinct regional differences in agricultural practices, localised market conditions, or energy access. District-level baseline studies may be permitted as valid sources where official national statistics are unavailable or distort the target demographic.

d. **Target Market Size** (P_{all})**:** Shall be defined strictly on technical applicability and regulatory boundaries. Socioeconomic segmentation is permitted if affordability is a rigorously justified primary structural barrier defining the accessible market.

e. **Similar Activities (P_{sim}) & Attribute Matrix:** Similarity shall be defined using the Attribute Matrix below. Factors related to scale (capacity/output), market conditions, policy incentives, or investment costs shall not be used as differentiating attributes. Activities substantially supported by international climate finance, ODA, or previously registered carbon market schemes shall be explicitly excluded from P_{sim}.

f. If the calculated Common Practice Factor $F = \frac{P_{sim}}{P_{all}}$ is ≥ F_{max}, the activity is common practice and not additional.

Table 6: Attribute Matrix for Biogas digesters

Attribute	Description	Required for Similarity (Yes/No)
Technology Principle	Controlled anaerobic digestion with methane capture.	Yes

Primary Feedstock	Animal manure (co-digestion permissible).	Yes
Application	Utilization of captured biogas for energy generation.	Yes
Exclusion of Carbon Finance	Technologies distributed, subsidised, or maintained via voluntary or compliance carbon market mechanisms shall be explicitly excluded from the count when calculating the common practice penetration rate.	Yes
Specific Design	e.g., Fixed dome vs. floating drum.	No

6.7.2.1 | **Common Practice Threshold (Fmax):** Using the Stock-Based Approach, a uniform Common Practice Threshold (Fmax) of 25% shall be applied across all regions.

6.8 | Ongoing Financial need

6.8.1 At the renewal of the crediting period, the additionality of the activity shall be reassessed in line with Gold Standard requirements.

6.8.1.1 | **Positive List Exemption:** Activities that qualified for and remain eligible under a recognized GS4GG Positive List (Deemed Additionality) are exempt from the Ongoing Financial Need (OFN) demonstration at crediting period renewal.

6.8.1.2 | **Demonstration of OFN[6]:** For all other activities, the developer shall demonstrate Ongoing Financial Need (OFN), providing evidence (e.g., updated financial analysis or funding assessment) that the activity still requires income from carbon credits to remain operational and sustainable in the renewed period.

7| BASELINE SCENARIO

7.1 | Baseline Determination (Stepwise Approach)

7.1.1 The crediting baseline emissions (BE_y) shall be determined following the stepwise approach mandated by the *GS4GG Standard: Requirements for*

[6] Reductions in crediting volume resulting directly from methodology updates implemented by Gold Standard (e.g., application of the Downward Adjustment Factor [DAF], revised fNRB rules, or tightening of uncertainty rules) shall be recognized as a valid quantitative justification for demonstrating Ongoing Financial Need during the financial reassessment.

Baseline Setting. The total Baseline Emissions are the sum of the emissions from the baseline AWMS component and the baseline Thermal Application (TA) component.

$$BE_y = BE_{AWMS} + BE_{TA,y} \qquad \text{(Eq. 1)}$$

7.1.2 The stepwise approach involves:

a. Step 1: Selection and Justification of the Baseline Approach (Section 7.2 |).

b. Step 2: Application of the selected approach prior to downward adjustment (Section 7.3 |).

c. Step 3: Application of the Downward Adjustment (Uncertainty and Ambition) (Section 7.4 |).

d. Step 4: Identification of a conservative Business-as-Usual (BAU) baseline (Section 7.5 |).

e. Step 5: Comparison and selection of the final Crediting Baseline (BE_y) (Section 7.6 |).

7.2 | Step 1: Selection of and Justification of the Baseline Approach

7.2.1 **Selection of Baseline Approach:** This methodology utilises approach (c) from paragraph 5.6.2 of the Methodology Standard - Requirements for Methodology Development: *An approach based on existing actual or historical emissions, adjusted downwards*.

7.2.2 **Justification for the Baseline Approach**: The selection of approach (c) is justified as follows:

a. **Appropriateness to Activity Context:**

i. **AWMS:** Emissions are calculated based on historical waste management practices and livestock populations using established IPCC methodologies (Tier 1 or Tier 2).

ii. **Thermal Application:** Emissions are based on historical fuel consumption patterns, determined via field tests (KPTs) or conservative defaults.

b. **Ensuring Conservativeness (Downward Adjustment):** The calculated emission reductions are adjusted downwards by:

i. Applying statistical conservativeness (e.g., 90/10 rule) to account for sampling uncertainty (Section 7.4.1).

ii. Applying the Downward Adjustment Factor (DAF) to encourage ambition over time (Section 7.4.5).

7.3 | Step 2: Application of the Selected Approach (Prior to Downward Adjustment)

7.3.1 Identification and Justification of the Baseline Scenario

7.3.1.1 | The baseline scenario shall be determined ex-ante via a Baseline Scenario Survey (BSS). The results of the BSS shall remain valid for the crediting period. A new BSS shall be conducted at each crediting period renewal.

a. **AWMS Baseline:** The scenario where, in the absence of the activity, animal manure is left to decay anaerobically (e.g., in pits, lagoons, stockpiles) and methane is emitted to the atmosphere. The BSS shall determine the types of livestock (LT), the average population (N_{LT}), and the fraction of manure handled in each baseline system ($MS\%_{Bl,j}$).

b. **Thermal Application Baseline:** The existing technology use and fuel consumption patterns (fossil fuels and/or biomass) used to meet the thermal energy needs that the biogas will displace. The BSS shall identify the fuel mix, technologies, and consumption levels.

7.3.1.2 | The baseline scenario is the mix of technologies and fuels that would be used by the target population in the absence of the activity. Activity developers shall identify distinct baseline scenarios (b) when the activity targets populations with significantly different fuel consumption patterns, livestock practices, or baseline technologies (e.g., rural users predominantly using wood vs. urban users predominantly using charcoal).

7.3.1.3 | The baseline is considered fixed for the duration of the 5-year crediting period. It shall be reassessed at the renewal of the crediting period (See Section 17|). In the event of a conflict regarding baseline reassessment schedules, the requirements of this methodology shall explicitly supersede the exemptions provided in the overarching Community Services Activity (CSA) Requirements.

7.3.1.4 | When the activity includes different activity technology types (p), the developer shall analyse whether these technologies relate to different baseline scenarios. Multiple activity scenarios can be credited against the same baseline scenario if applicable.

7.3.1.5 | The identification and description of the baseline scenario shall be informed by a statistically representative Baseline Scenario Survey (BSS) of the target population.

7.3.2 **Consistency Check between Baseline Scenario and Activity Participants**: The activity developer shall verify that the baseline characteristics (manure management practices, fuel mix, and household size) determined via the BSS are representative of the actual participants recruited into the activity.

7.3.2.1 | This assessment shall be carried out during the first usage survey using standardised retrospective questions asked of actual activity participants regarding their practices immediately prior to receiving the activity technology. The recall period shall be standardised across the activity as "the typical practices during the 30 days prior to receiving the activity technology." The minimum parameters to be queried include:

a. Number of individuals utilising the thermal service (Household Size).

b. Primary baseline fuel type and/or primary baseline manure management practice.

c. Secondary baseline fuel type(s).

7.3.2.2 | **Assessment of Material Discrepancy:** A material discrepancy occurs if the comparison reveals a non-conservative baseline (i.e., the actual field population presents a "cleaner" or lower-emitting profile than the ex-ante assumptions), defined as:

a. **AWMS:** More than a 20% absolute difference (relative to the activity estimate). The actual fraction of manure managed in the primary anaerobic baseline system ($MS\%_{Bl,j}$) is demonstrably lower than the activity estimate, AND this difference results in lower ex-ante baseline emissions.

b. **Thermal:** More than a 20% absolute difference (relative to the activity estimate). The actual proportion of cooking events using the primary high-emitting fuel type is lower than the activity estimate, AND this difference results in lower baseline emissions.

c. **Household Size:** The average household size measured during the first activity usage survey is smaller than the baseline scenario estimate.

7.3.2.3 | **Resolutions (Hybrid/Threshold Approach):** Where a material discrepancy occurs, the activity developer shall implement the following conservative resolutions:

a. **Cluster Separations:** Activity developers may utilise cluster separations (e.g., stratifying the population strictly by single-fuel users vs. mixed-fuel users, or by livestock holding sizes) to resolve apparent discrepancies and improve demographic matching prior to applying adjustments. Any cluster separations utilised shall be based on objective stratifications explicitly defined ex-ante.

b. **Deviations below the Validity Threshold (≤ 20%):** If the absolute deviation between the baseline estimate and the actual deployed population is 20% or less, the activity developer shall apply a conservative mathematical downward adjustment to the baseline parameters ($MS\%_{Bl,j}$, fuel mix, or household size). The baseline emissions shall be adjusted to match the empirically observed, lower-emitting participant profile. Adjustments are made

cumulatively, and the approach is designed to minimise monitoring burden while ensuring accuracy.

c. **Deviations exceeding the Validity Threshold (> 20%):** If the deviation exceeds 20%, the shift indicates a fundamental divergence from the target demographic. The original Baseline Scenario is deemed statistically invalid for that specific cohort, and the activity developer shall formally redefine the baseline scenario for the affected segment via a new baseline survey.

d. **Prohibition on Exclusion:** Activity developers shall not arbitrarily exclude non-conforming, lower-emitting households or farms from the monitoring sample solely to artificially force compliance with an aggressive baseline.

7.3.3 **Cross-Effects**: In activities targeting multiple distributed technologies (e.g., biodigesters and safe water supply), cross-effects shall be accounted for. The baseline scenario shall be defined such that baseline resource use (e.g., fuel) is divided appropriately between the technologies without double counting.

7.3.4 **Suppressed Demand Assessment**

7.3.4.1 | The methodology allows for the baseline thermal scenario to account for suppressed demand if the pre-activity energy consumption is below the level required to meet basic human needs.

a. **AWMS Component:** Suppressed demand is not applicable.

b. **Thermal Component:** If the developer provides verifiable evidence that the target population is energy-poor, the baseline thermal consumption ($P_{b,mean}$) may be set at the Minimum Service Level (MSL) (See Option C).

7.3.5 **Overview of Calculation Approaches**.

7.3.5.1 | The methodology provides flexibility based on scale and data availability (See Section 3.2.5 for applicability).

Table 7: Overview of Baseline Calculation Methods

Component	Method	Description	Data Requirements
AWMS	Method 1 (Tier 1)	Simplified IPCC approach.	Livestock population, climate, baseline management practice ($MS\%$).
	Method 2 (Tier 2)	Detailed IPCC approach.	Detailed livestock data (VS, Bo), climate (MCF).
Thermal Application	Method 1 (Non-Metered)	Based on avoided quantity of baseline fuel consumption.	KPT (Option A) or Defaults/MSL (Options B/C).

Method 2 (Metered)	Based on useful energy generated from metered biogas consumption.	Biogas meters, baseline/activity efficiencies.

7.3.6 Calculation of Unadjusted Baseline Emissions ($BE_{unadj,y}$)

7.3.6.1 | The Unadjusted Baseline Emissions ($BE_{unadj,y}$) are calculated using the mean values of sampled parameters, prior to downward adjustments.

$$BE_{unadj,y} = BE_{AWMS,unadj,y} + BE_{TA,unadj,y} \quad \text{(Eq. 2)}$$

Where:

$BE_{unadj,y}$	=	Unadjusted baseline emission in year y (tCO_2e/yr)
$BE_{AWMS,unadj,y}$	=	Unadjusted AWMS baseline emission in year y (tCO_2e/yr)
$BE_{TA,unadj,y}$	=	Unadjusted thermal application baseline emission in year y (tCO_2e/yr)

7.3.6.2 | **AWMS Method 1 (IPCC Tier 1) ($BE_{AWMS,unadj,y}$):** Calculated using Method 1 (Tier 1) based on the mean livestock population ($N_{LT,mean}$).

$$BE_{AWMS,unadj,y} = \left(\frac{N_{b,p,y}}{365}\right) \times GWP_{CH4} \times UF_b \times U_{p,y} \times \sum_{j.LT} \left(\frac{N_{LT,mean,y} \times VS_{LT,y} \times MS\%_{Bl,j} \times EF_{LT}}{1000}\right) \quad \text{(Eq. 3)}$$

Where:

$BE_{AWMS,unadj,y}$	=	Unadjusted AWMS baseline emissions in year y (tCO_2e/yr)
$N_{b,p,y}$	=	Number of activity technology-days (days)
GWP_{CH4}	=	Global Warming Potential of CH_4 (tCO_2e/tCH_4)
UF_b	=	Model correction factor to account for model uncertainties (0.89)[7]
$U_{p,y}$	=	Usage rate of the activity technology (%)
$N_{LT,mean,y}$	=	Mean annual average number of animals of type LT (See 7.3.6.4 |) (numbers)
$VS_{LT,y}$	=	Volatile solids production per animal of type LT (See 7.3.6.5 |)
$MS\%_{Bl,j}$	=	Fraction of manure handled in baseline system j (%)
EF_{LT}	=	Emission factor for CH_4 emissions by livestock LT (kg CH_4/kg-dm)

[7] Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

$LT_{,j}$ = Index for Livestock Type (LT) and management system (j)

7.3.6.3 | **AWMS Method 2 (IPCC Tier 2)**

$$BE_{AWMS,unadj,y} = \left(\frac{N_{b,p,y}}{365}\right) \times GWP_{CH4} \times D_{CH4} \times UF_b \times U_{p,y} \times \sum_{k,j.LT}(N_{LT,mean,y} \times B_{0,LT} \times VS_{LT,y} \times MCF_{j,k} \times MS\%_{Bl,j}) \quad \text{(Eq. 4)}$$

Where:

D_{CH4} = Density of CH4 (Default: 0.00067 t/m^3)

UF_b = Model correction factor (Default: 0.94)

$B_{0,LT}$ = Maximum methane production potential of VS for animal LT (m^3 CH_4/kg-dm)

$MCF_{j,k}$ = Methane conversion factor for system j in climate region k (%)

k = Index for climate region

(Other parameters as defined in Eq. 3)

7.3.6.4 | **Determination of Mean Livestock Population ($N_{LT,mean,y}$):** The mean annual average number of animals ($N_{LT,mean,y}$) shall be determined ex-ante via a statistically representative Baseline Scenario Survey. Where robust, complete farm-level livestock records are available, directly monitored livestock data over the monitoring period may be utilised in place of Eq. 5, subject to VVB verification.

$$N_{LT,mean,y} = N_{da} \times \left({}^{N_p}/_{365}\right) \quad \text{(Eq. 5)}$$

Where:

N_{da} = Average number of days animals are alive in the farm per year (day)

N_p = Average number of animals produced annually of type LT (numbers)

7.3.6.5 | **Determination of Volatile Solids ($VS_{LT,y}$) and Typical Animal Mass ($\boldsymbol{TAM}$):** $VS_{LT,y}$ shall be determined using country-specific data (preferred), IPCC defaults, or calculated based on feed intake.Typical Animal Mass ($\boldsymbol{TAM}$) shall be determined as follows:

a. **Default Approach:** $\boldsymbol{TAM}$ shall be determined using the most recent IPCC default values applicable to the livestock category and region.

b. **Alternative (National or Regional Data):** Activities may use officially available, nationally or regionally derived Typical Animal Mass values instead of generic IPCC defaults, provided that:

i. The data originate from official national livestock census statistics, government publications, peer-reviewed literature or recognised agricultural research institutions;

ii. The data are publicly available or otherwise verifiable by the VVB;

iii. The data are not selectively chosen and strictly are representative of the livestock category and geographic region of the activity; and

iv. The source, publication year, and justification for applicability are transparently documented in the Project Design Document and Monitoring Report.

c. **Conservativeness Requirement:** Where multiple data sources are available, the selected $\boldsymbol{TAM}$ value shall be justified and applied in a manner that does not result in an overestimation of baseline emissions. The VVB shall assess appropriateness and consistency during validation and verification.

Option 1: Weight-based calculation (Using IPCC defaults or country-specific rates)

$$VS_{LT,y} = \left(VS_{rate,LT} \times {TAM_{LT}}/{1000}\right) \times nd_y \qquad \text{(Eq. 6)}$$

Where:

$VS_{rate,LT}$	=	VS excretion rate (IPCC 2019 or national data) (kg VS/(1000 kg animal mass)/day)
TAM_{LT}	=	Typical animal mass for livestock LT (kg/animal)
nd_y	=	Number of days (e.g., 365 for annual baseline) (days)

Option 2: Energy Intake Calculation (If detailed feed data is available)

$$VS_{LT,y} = \left[GE_{LT} \times \left(1 - \frac{DE_{LT}}{100}\right) + (UE \times GE_{LT})\right] \times \left[\left(\frac{1-ASH}{ED_{LT}}\right)\right] \times nd_y \qquad \text{(Eq. 7)}$$

Where:

GE_{LT}	=	Daily average gross energy intake (MJ/animal/day)
DE_{LT}	=	Digestible energy of the feed (%)
UE	=	Urinary energy (fraction of GE_{LT})
ASH	=	Ash content of feed calculated as a fraction of the dry matter feed intake.
ED_{LT}	=	Energy density of the feed (Default: 18.45) (MJ/kg-dm)

7.3.6.6 | **Thermal Method 1: Avoided Fuel Consumption (Non-Metered)** ($BE_{TA,unadj,y}$): Calculated using Method 1 (Avoided Fuel), applicable to all baseline fuels displaced by the activity

$$BE_{TA,unadj,y} = \sum_{b,p}\left(N_{b,p,y} \times U_{p,y} \times P_{b,mean} \times NCV_{b,fuel} \times \left(EF_{b,f,CO2} \times fNRB_{b,y} + EF_{b,f,non-CO2}\right)\right) \quad \text{(Eq. 8)}$$

Where:

$BE_{TA,unadj,y}$	=	Unadjusted Thermal baseline emissions in year y (tCO_2e/yr)
$N_{b,p,y}$	=	Number of activity technology-days (days)
$U_{p,y}$	=	Usage rate of the activity technology (%)
$P_{b,mean}$	=	Mean quantity of fuel(s) consumed in baseline scenario b (tonnes/household/day or unit)
$NCV_{b,fuel}$	=	Net calorific value of the baseline fuel(s)
$EF_{b,f,CO2}$	=	CO_2 emission factor from use of fuel(s) f
$fNRB_{b,y}$	=	Fraction of non-renewable biomass (Baseline). (fNRB=1 for fossil fuels)
$EF_{b,f,non-CO2}$	=	Non-CO_2 emission factor of baseline fuel(s) f
b	=	Index for baseline scenario
p	=	Index for activity scenario

7.3.6.7 | **Determination of Mean Baseline Fuel Consumption ($P_{b,mean}$):** $P_{b,mean}$ shall be determined using one of the following options:

a. **OPTION A: Historical Consumption (B-KPT):** $P_{b,mean}$ is determined ex-ante via a statistically representative Baseline KPT (B-KPT).

b. **OPTION B: Default Consumption:** $P_{b,mean}$ is based on conservative defaults (e.g., 0.5 tonnes wood/capita/year or 0.13 tonnes charcoal/capita/year), and shall be applied only where the fuelwood is used as the primary cooking fuel i.e., primary baseline fuel (≥90%) is wood or charcoal.

c. **OPTION C: Suppressed Demand (MSL):** $P_{b,mean}$ is set equal to the Minimum Service Level (P_{MSL}), based on the defaults in Option B multiplied by household size [adjusted to standard adult equivalent based], if suppressed demand is demonstrated.

7.3.6.8 | **Definition of Defaults and MSL:**

a. The global default for baseline fuelwood consumption (Option B/C) is equivalent to 0.5 tonnes/(capita/year) of air-dried wood (0.0078 TJ/person year).

b. The global default for baseline charcoal consumption (Option B/C) is equivalent to 0.13 tonnes/(person year) (0.00295 TJ/person year).

c. These defaults represent the Minimum Service Level (MSL) of energy required for cooking.

7.3.6.9 | **Thermal Method 2: Useful Energy (Metered Biogas)**

$$BE_{TA,unadj,y} = EG_{p,useful,y} \times EF_{b,useful} \quad \text{(Eq. 9)}$$

Where:

$EG_{p,useful,y}$ = Useful energy delivered by the activity devices in year y (See Eq. 10)

$EF_{b,useful}$ = Baseline emissions factor (Unadjusted) (See Eq. 11) (tCO_2e/TJ useful energy)

$$EG_{p,useful,y} = Q_{biogas,y} \times NCV_{biogas} \times \eta_{p,mean} \quad \text{(Eq. 10)}$$

Where:

$Q_{biogas,y}$ = Metered volume of biogas used in year y (m^3/yr)

NCV_{biogas} = Net calorific value of biogas (Default: 0.02154 GJ/m^3)

$\eta_{p,mean}$ = Mean thermal efficiency of the activity device (%)

$$EF_{b,useful} = \sum_{i,j}\left(Prop_{i,j} \times NCV_{b,i} \times \left(EF_{b,i,CO2} \times fNRB_{i,y} + EF_{b,i,non-CO2}\right)\right) \Big/ \sum_{i,j}\left(Prop_{i,j} \times NCV_{b,i} \times \eta_{b,i,j,mean}\right) \quad \text{(Eq. 11)}$$

Where:

$Prop_{i,j}$ = Proportion of total cooking performed using fuel *i* in device *j* in the baseline scenario (fraction)

$NCV_{b,i}$ = Net Calorific Value of baseline fuel *i* (TJ/tonne)

$EF_{b,i,CO2}$ = CO_2 emission factor (combustion) for baseline fuel *i* (tCO_2/TJ)

$fNRB_{i,y}$ = Fraction of non-renewable biomass for fuel *i* in year y (fraction; fNRB=1 for fossil fuels)

$EF_{b,i,non-CO2}$ = Non-CO_2 (CH_4 and N_2O) emission factor (combustion) for baseline fuel *i* (tCO_2e/TJ)

$\eta_{b,i,j,mean}$ = Efficiency of baseline device *j* with fuel *i* (Unadjusted Mean) (fraction)

i = Index for baseline fuel type

j = Index for baseline device type

7.4 | Step 3: Application of the Downward Adjustment

7.4.1 Adjustment for Uncertainty

7.4.1.1 | The baseline parameters derived from sampling shall be adjusted downwards to account for uncertainty if the required statistical precision is not met.

7.4.1.2 | **Required Precision:** The "90/10 Rule" (90% confidence, 10% precision) shall apply to the key parameters determined via sampling/surveys:

a. $N_{LT,mean}$ (Livestock population)

b. $P_{b,mean}$ (Baseline fuel(s) consumption) (If Thermal Method 1, Option A used)

c. $\eta_{b,mean}$ (Baseline efficiency) (If Thermal Method 2 used)

d. $\eta_{p,mean}$ (Activity efficiency) (If Thermal Method 2 used)

7.4.1.3 | **Statistical Adjustment Procedure:**

a. If the 90/10 Rule is met: The Mean value shall be used. (e.g., $N_{LT,adj} = N_{LT,mean}$).

b. If the 90/10 Rule is NOT met: The activity developer may undertake additional sampling to meet the confidence/precision requirement. Where additional sampling is not undertaken, or the requirement remains unmet, the conservative bound of the one-sided 90% confidence interval shall be used:

i. Parameters increasing the baseline (N_{LT}, P_b): The Lower Bound (LB90) shall be used.

$$N_{LT,adj} = N_{LT,LB90} \quad \text{(Eq. 12)}$$

$$P_{b,adj} = P_{b,LB90} \quad \text{(Eq. 13)}$$

ii. Baseline Efficiency (η_b): The Upper Bound (UB90) shall be used (A higher η_b results in a lower $EG_{b,useful}$, thus lower BE_{TA}).

$$\eta_{b,adj} = \eta_{b,UB90} \quad \text{(Eq. 14)}$$

iii. Activity Efficiency (η_p): The Lower Bound (LB90) shall be used (A lower η_p results in lower $EG_{p,useful,y}$, thus lower BE_{TA}).

$$\eta_{p,adj} = \eta_{p,LB90} \quad \text{(Eq. 15)}$$

7.4.1.4 | **Adjustment for Defaults (Thermal Method 1, Options B/C):**

a. Option B (Default): No statistical adjustment required. $P_{b,adj} = P_{b,mean}$.

b. Option C (MSL): A mandatory 5% deduction is applied to ensure conservativeness.

$$P_{b,adj} = P_{MSL} \times 0.95 \quad \text{(Eq. 16)}$$

7.4.2 Capping (Conservativeness - Thermal Component):

7.4.2.1 | If Thermal Method 1 (Option A - KPT) or Thermal Method 2 (Metered) is used, the resulting statistically adjusted baseline consumption ($P_{b,adj}$or back-calculated equivalent) shall be capped to ensure realism. Because KPT results are measured per household, the average baseline household size (HN_b) shall be explicitly applied to mathematically convert the per-capita cap values to household limits.

a. **Primary Fuelwood Users (≥90% wood):**

i. Threshold (requires justification if exceeded): 0.75 tonnes/person/year (air-dried wood equivalent).

ii. Cap Value (P_{CAP}): 1.25 tonnes/person/year.

b. **Primary Charcoal Users or Mixed Baselines:**

i. Threshold (requires justification if exceeded): 0.20 tonnes/person/year (charcoal equivalent).

ii. Cap Value (P_{CAP}): 0.40 tonnes/person/year.

7.4.3 The final adjusted value used for calculation shall be the lower of the statistically adjusted value and the Cap.

$$P_{b,final} = MIN\left(P_{b,adj}, \left(\frac{P_{CAP} \times HN_b}{365}\right)\right) \qquad \text{(Eq. 17)}$$

Where:

HN_b = Average number of individuals per household in the baseline scenario.

7.4.4 Calculation of Uncertainty-Adjusted Baseline Emissions ($BE_{unc,y}$)

7.4.4.1 | The Baseline Emissions adjusted for uncertainty ($BE_{unc,y}$) are calculated replacing the mean parameters with the final adjusted parameters ($N_{LT,adj}$, $P_{b,final}$, $\eta_{b,adj}$,$\eta_{p,adj}$) following the application of the 90/10 precision check in the respective equations in Section 7.3 |.

7.4.5 Adjustment For Ambition (DAF)

7.4.5.1 | The applicable DAF ($DAF_{NetZero}$) shall be applied to the Uncertainty-Adjusted Baseline Emissions to encourage ambition over time. This factor shall be sourced from the GS4GG Methodology Tool: DAF Determination. The DAF is intended to be applied as an adjustment to the annual baseline emission estimate, not compounded annually. If a host country has no published Net-Zero trajectory, the default fallback DAF provided in the tool shall be applied.

7.4.5.2 | Calculation of Downward Adjusted Baseline Emissions ($BE_{adj,y}$)

$$BE_{adj,y} = BE_{unc,y} \times (1 - DAF_{NetZero}) \qquad \text{Eq. 18}$$

Where:

$BE_{adj,y}$ = Downward Adjusted Baseline Emissions in year y (tCO_2e/yr)

$BE_{unc,y}$ = Baseline Emissions adjusted for uncertainty in year y (tCO_2e/yr)

$DAF_{NetZero}$ = Downward Adjustment Factor for Net Zero alignment (fraction)

7.5 | Step 4: Identification and Calculation of the Conservative BAU Scenario

7.5.1 The conservative Business-as-Usual (BAU) scenario accounts for uncertainty but excludes the Adjustment for Ambition (DAF).

$$BAU_y = BE_{unc,y} \qquad \text{Eq. 19}$$

Where:

BAU_y = Conservative Business-as-Usual emissions in year y (tCO_2e/yr)

$BE_{unc,y}$ = Baseline Emissions adjusted for uncertainty in year y (tCO_2e/yr)

7.6 | Step 5: Comparison and Selection of the Crediting Baseline (BE_y)

7.6.1 The final Crediting Baseline (BE_y) shall be the lower value between the Downward Adjusted Baseline emissions ($BE_{adj,y}$) and the Conservative BAU (BAU_y).

$$BE_y = MIN\left(BE_{adj,y}, BAU_y\right) \qquad \text{Eq.20}$$

Where:

BE_y = Crediting Baseline Emissions in year y (tCO_2e/yr)

$BE_{adj,y}$ = Downward Adjusted Baseline Emissions in year y (tCO_2e/yr)

BAU_y = Conservative Business-as-Usual emissions in year y (tCO_2e/yr)

7.7 | Quantification of the Difference between BAU and Crediting Baseline

7.7.1 As required by the Methodology Standard: Requirements for Baseline Setting, the difference between the Conservative BAU emissions (BAU_y) and the final Crediting Baseline Emissions (BE_y) shall be quantified and reported transparently in the Monitoring Report.

7.7.2 This difference represents the emissions excluded from crediting due to the application of the Downward Adjustment Factor (DAF) for ambition.

$$\Delta_y = BAU_y - BE_y \qquad \text{Eq. 21}$$

Where:

Δ_y	=	Emissions excluded from the crediting baseline due to ambition adjustment (DAF) in year y
BAU_y	=	Conservative Business-as-Usual emissions in year y
BE_y	=	Crediting Baseline Emissions in year y

8| ACTIVITY EMISSIONS

8.1 | Identification of the Activity Scenario

8.1.1 The activity scenario is defined by the implementation of the activity technologies and practices, including:

a. The operation of the anaerobic digester system (AWMS).

b. The management and transportation of inputs (manure, co-digestion feedstock) and outputs (digestate).

c. The utilization of the biogas for thermal energy, including any continued use of baseline technologies ("stove stacking").

8.1.2 When different activity technologies are included in an activity, the activity developer shall analyse whether multiple activity scenarios (p) should be identified.

8.1.3 Activity technologies with similar design and performance characteristics may be included under a single activity scenario. Similarity is defined as technologies based on the same fundamental technology (e.g., combustion principle) whose respective biogas digester (e.g., gas holding) capacity do not differ by more than +/-5% in absolute terms from the design implemented most frequently.

8.1.4 Technologies with significantly different performance characteristics (more than +/-5%) shall be treated as independent activity scenarios and monitored and calculated separately.

8.2 | Calculation of total activity emissions

8.2.1 Activity emissions (AE_y) are all anthropogenic emissions occurring within the activity boundary attributable to the activity.

$$AE_y = AE_{AWMS,y} + AE_{TA,y} \qquad \text{Eq. 22}$$

8.2.2 **AWMS Method 1 (IPCC Tier 1) ($AE_{AWMS,y}$)**

8.2.2.1 | The calculation method (1 or 2) shall match the method selected for the baseline calculation.

a. AWMS Method 1 (Tier 1)

$$AE_{AWMS,y} = AE_{PL,y} + AE_{power,y} \quad \text{Eq. 23}$$

Where:

$AE_{AWMS,y}$ = Activity emissions from AWMS in year y (tCO_2e/yr)

$AE_{PL,y}$ = Activity emissions due to physical leakage of biogas (tCO_2e/yr)

$AE_{power,y}$ = Activity emissions from operational use of fossil fuel and/or electricity (tCO_2e/yr)

b. AWMS Method 2 (Tier 2)

$$AE_{AWMS,y} = AE_{PL,y} + AE_{power,y} + AE_{transport,y} + AE_{storage,y} \quad \text{Eq. 24}$$

Where:

$AE_{transport,y}$ = Activity emissions from incremental transportation (tCO_2e/yr)

$AE_{storage,y}$ = Activity emissions from pre-digestion manure storage (tCO_2e/yr)

(Other parameters as defined in Eq. 23)

8.2.2.2 | **Physical Leakage ($AE_{PL,y}$)**: Physical leakage from the biodigester system (including fugitive emissions and emergency venting) shall be calculated using one of the following options:

a. **Option 1 (Default):** Calculated as 10% of the maximum methane production potential of the manure fed into the system. This calculation shall use the Uncertainty-Adjusted livestock parameters ($N_{LT,adj}$) determined in Section 7.4 |.

$$AE_{PL,y} = 0.10 \times \left(\frac{N_{b,p,y}}{365}\right) \times U_{p,y} \times GWP_{CH4} \times D_{CH4} \times \sum_{k,i,LT}\left[B_{0,LT} \times N_{LT,adj} \times VS_{LT} \times MS\%_{p,i}\right] \quad \text{Eq. 25}$$

Where:

0.10 = Default leakage factor (%)

$N_{b,p,y}$ = Number of activity technology-days (days)

$U_{p,y}$ = Usage rate of the activity technology (%)

GWP_{CH4} = Global Warming Potential of CH_4 (t_{CO2e}/t_{CH4})

D_{CH4} = Density of CH_4 (Default: 0.00067 t/m^3) (t/m^3)

$B_{0,LT}$ = Maximum methane production potential of VS for animal LT (m^3 CH_4/kg-dm)

$N_{LT,adj}$ = Uncertainty-Adjusted annual average number of animals (from Section 7.4.2) (numbers)

VS_{LT} = Volatile solids production per animal of type LT (kg-dm/animal/yr)

$MS\%_{p,i}$ = Fraction of manure handled in activity AWMS (%)

Note: This calculation requires the use of $B_{0,LT}$ even if Method 1 is applied)

b. **Option 2 (Monitoring-Based Physical Leakage):** Where robust and reliable measurement data are available, activity developers may replace the default 10% value with monitored leakage results. This includes data derived from continuous gas flow metering (e.g., smart biogas meters capable of capturing leaked/vented volumes), gas-tightness checks, pressure-drop tests, or targeted leak detection methods quantified following the relevant procedures in TOOL 14. Smart meters that measure consumption can still support conservative monitoring, and TOOL 14 allows leakage estimation without requiring production metering as a mandatory condition. The application of this option is strictly subject to documented quality assurance, equipment calibration, and rigorous VVB verification to ensure all physical leakage is accurately captured.

8.2.2.3 | **Operational Energy Use ($AE_{power,y}$):** Emissions from the use of fossil fuels and/or electricity for the operation of the AWMS (e.g., pumps, mixers) shall be determined using GS TOOL 01 or A6.4-AMT-007.

8.2.2.4 | **Incremental Transport ($PE_{transport,y}$) (Method 2 Only):** Activity emissions due to incremental transport distances for raw manure (input) and residual waste/digestate (output) shall be calculated. To ensure symmetrical accounting, if baseline fuel transportation emissions are included, activity transportation emissions shall also be included, regardless of distance.

$$PE_{transp,y} = EF_{Co2,transp} \times \left[\left(\frac{Q_y}{CT_y}\right) \times D_w \times \left(\frac{Q_{res,y}}{CT_{res,y}}\right) \times D_{res}\right] \div 1000 \quad \text{Eq. 26}$$

Where:

$EF_{Co2,transp}$ = CO_2 emission factor from fuel use for transportation (IPCC or local values) ($kgCO_2$/km)

Q_y = Quantity of raw manure treated in year y (tonnes)

$Q_{res,y}$ = Quantity of residual waste treated in year y (tonnes)

CT_y = Average truck capacity for manure (tonnes/truck)

$CT_{res,y}$ = Average truck capacity for residual waste (tonnes/truck)

D_w = Average incremental distance for manure transport (km/truck)

D_{res} = Average incremental distance for residual waste transport (km/truck)

8.2.3 **Pre-Digestion Storage ($AE_{storage,y}$) (Method 2 Only):** Emissions from manure storage before being fed into the digester shall be accounted for ONLY IF both conditions below are met:

a. The storage time after removal from the animal barns exceeds 24 hours; AND

b. The dry matter content of the manure when removed from the barns is less than 20%.

$$AE_{storage} = GWP_{CH4} \times D_{CH4} \times \sum_{LT,l}\left[\frac{365}{AI_l} \times \sum_{d=1}^{AI}\left(N_{LT} \times VS_{LT,d} \times MS\%_l \times \left(1 - e^{-k(AI_l - d)}\right) \times MCF_i \times B_{0,LT}\right)\right] \quad \text{Eq. 27}$$

Where:

AI_l = Annual average interval between manure collection and delivery for treatment at a given storage device l (days)

$VS_{LT,d}$ = Amount of volatile solid production by type of animal LT in a day (kg VS/head/d)

$MS\%_l$ = Fraction of volatile solids (%) handled by storage device l

k = Degradation rate constant (0.069)

d = Days for which cumulative methane emissions are calculated; d can vary from 1 to 45 and to be run from 1 up to AI_l

MCF_l = Annual methane conversion factor for the activity manure storage device from Table 10.17, Chapter 10, Volume 4

8.2.4 **Thermal Application Component ($AE_{TA,y}$)**

8.2.4.1 | **Thermal Method 1: Avoided Fuel Consumption (Non-Metered)**: Activity emissions shall account for the total fuel consumed, including biogas and any continued use of baseline technologies ("stove stacking"). This is determined via a statistically representative Project KPT (P-KPT).

8.2.4.2 | **Timing and Seasonality of P-KPTs:** The P-KPT may be conducted at any representative time within the monitoring period to adequately capture seasonal variations. If seasonal variations (e.g., wet vs. dry seasons) materially impact fuel use, the KPT sampling shall be staggered or mathematically weighted to accurately account for both seasons.

8.2.5 **Internalisation of Stove Stacking:**

a. **Stacking with Baseline Devices:** The P-KPT shall physically measure the fuel used in the activity technology AND any continued

use of the baseline technology operating in parallel. Because the total fuel consumed by stacked baseline devices is fully captured and integrated into the physical P-KPT measurement, the stove stacking fraction calculated from qualitative Usage Surveys shall NOT be applied as a secondary mathematical discount factor in the emission reduction equations, preventing double-penalizing the activity.

b. **Stacking with Non-Activity Improved Devices:** If the household has acquired a new improved cooking device (not attributable to the activity) since the baseline was established, the energy consumed by this non-activity device shall be measured or conservatively estimated. To prevent free-riding and double-claiming, the baseline fuel equivalent of the energy consumed by the non-activity device shall be mathematically added to the Activity Emissions ($AE_{TA,y}$) for that household, OR used to proportionally adjust the household's Baseline Emissions (BE_y) downward.

$$AE_{TA,y} = \sum_{b,p}\left(N_{b,p,y} \times U_{p,y} \times (P_{p,adj} \times NCV_{p,fuel} \times \left(EF_{p,f,Co2} \times fNRB_{p,y} + EF_{p,f,nonCO2}\right)\right) \quad \text{Eq.28}$$

Where:

$AE_{TA,y}$	=	Activity emissions from Thermal Application in year y (tCO_2e/yr)
$P_{p,adj}$	=	Uncertainty-Adjusted quantity of fuel consumed in activity scenario, including any continued use of baseline stoves captured in the P-KPT
$NCV_{p,fuel}$	=	Net calorific value of the activity fuel(s)
$EF_{p,f,Co2}$	=	CO_2 emission factor of activity fuel f (Note: 0 for biogas)
$fNRB_{p,y}$	=	Fraction of non-renewable biomass (activity). (Note: 0 for biogas)
$EF_{p,f,nonCO2}$	=	Non-CO_2 emission factor of activity fuel f

8.2.5.1 | **Adjustment for Uncertainty ($P_{p,mean}$) (Method 1 Only):** The uncertainty associated with the P-KPT sampling results ($P_{p,mean}$) shall be addressed using the 90/10 rule. To ensure conservativeness, activity emissions shall not be underestimated. The 90/10 precision target applies to the overall weighted parameter ($P_{p,mean}$). While sampling shall be stratified by age cohort, 90/10 precision is not strictly required independently within each sub-cohort.

a. **If the 90/10 Rule is met:** The Mean value shall be used.

$$P_{p,adj} = P_{p,mean} \quad \text{(Eq. 29)}$$

b. **If the 90/10 Rule is NOT met:** The Upper Bound of the one-sided 90% confidence interval (UB90) shall be used.

$$P_{p,adj} = P_{p,UB90} \quad \text{(Eq. 30)}$$

8.2.5.2 | **Thermal Method 2: Useful Energy (Metered Biogas):** Activity emissions are calculated based on the metered biogas consumption. As metering provides a census of consumption, no statistical adjustment for uncertainty is required. Stove stacking is internalized in the baseline calculation (Section 7.3.9, Method 2). Because the metered volume (Q_{biogas}) inherently reflects the exact usage, the qualitative usage rate parameter is deliberately ($U_{p,y}$) excluded from this equation to avoid double-discounting.

$$AE_{TA,y} = Q_{biogas,y} \times NCV_{biogas} \times EF_{biogas,nonCO2} \quad \text{Eq.31)}$$

Where:

$Q_{biogas,y}$	=	Metered volume of biogas used in year y (m^3/yr)
NCV_{biogas}	=	Net calorific value of biogas (Default: 0.02154 GJ/m^3)
$EF_{biogas,nonCO2}$	=	Non-CO_2 (CH_4, N_2O) emission factor for biogas combustion (tCO_2e/GJ)

9| LEAKAGE EMISSIONS

9.1 | Identification of leakage emission sources

9.1.1 Leakage (LE_y) refers to the net change of GHG emissions occurring outside the activity boundary attributable to the activity. This shall include identifying leakage sources from AWMS, and thermal application.

9.1.2 **Avoidance or Minimisation of Leakage**: The activity developer shall at a minimum:

a. Ensure digestate handling and storage are carried out under aerobic conditions until field application.

b. Size gasholders and provide back-up utilisation (e.g., safety flare) to avoid venting, and implement maintenance plans, leak checks (soap test or equivalent), and rapid repair protocols.

c. Provide end-user training on safe operation, routine maintenance, and correct digestate application practices, and document all trainings.

9.2 | Quantification of Leakage

9.2.1 This methodology mandates the accounting of Embodied Emissions and the assessment of Net Leakage Effects (Resource Competition, Digestate Management, Positive Leakage, and Thermal Market Effects).

$$LE_y = LE_{Embodied,y} + LE_{Neteffects,y} \quad \text{(Eq.32)}$$

Where:

LE_y = Total Leakage Emissions in year y (tCO_2e/yr)

$LE_{Embodied,y}$ = Leakage due to embodied emissions in year y (tCO_2e/yr)

$LE_{NetEffects,y}$ = Net leakage from market, resource, and environmental effects (Section 9.3.5) (tCO_2e/yr)

9.3 | Embodied Emissions ($LE_{Embodied,y}$)

9.3.1 In compliance with cradle-to-gate assessment requirements, embodied emissions associated with the manufacturing and transport of the biodigesters and thermal devices shall be accounted for using conservative defaults derived from Life Cycle Assessment (LCA) literature or through independent third-party verified activity-specific LCAs.

$$LE_{Embodied,y} = LE_{Embodied,digester,y} + LE_{Embodied,thermal,y} \quad \text{(Eq. 33)}$$

9.3.2 **Household-Scale and Small-Farm Biodigesters (e.g., ≤ 20 m³)**: A mandatory conservative default deduction of **2.9 tCO_2e per system** shall be applied. Alternatively, to accommodate modern, low-carbon modular or membrane-based technologies, activity developers may use an activity-specific embodied emission value. This alternative value shall be strictly derived from a robust, transparently documented Life Cycle Assessment (LCA) compliant with ISO 14040/14044 standards and verified by an independent third party.

$$LE_{Embodied,digester,total} = N_{digester,new,y} \times EF_{emboided,digester} \quad \text{(Eq. 34)}$$

Where,

$LE_{Embodied,digester,total}$ = Total embodied emissions for the batch of new digesters

$N_{digester,new,y}$ = Number of new household/small-farm biodigesters installed in year y

$EF_{emboided,digester}$ = The default factor of 2.9 tCO_2e, OR the approved third-party verified LCA value (tCO_2e/unit)

9.3.3 **Large-Scale AD Plants (> 20 m³)**: Embodied emissions shall be calculated using the "0.6-power rule" (economy of scale). The activity developer shall justify the selection of representative LCA literature values for the baseline parameters ($E_{baseline}$, $Cap_{baseline}$).

$$LE_{Embodied,unit} = E_{baseline} \times \left(\frac{Cap_{activity}}{Cap_{baseline}}\right)^{\wedge 0.6} \quad \text{(Eq. 35)}$$

Where,

$LE_{Embodied,unit}$ = Embodied emissions for the activity unit (tCO_2e/unit)

$E_{baseline}$ = Embodied emissions of the baseline reference plant (from literature) (tCO_2e)

$Cap_{activity}$ = Installed capacity of the activity plant (kW or m^3)

$Cap_{baseline}$ = Installed capacity of the baseline reference plant (kW or m^3)

9.3.4 **Thermal devices**: A mandatory conservative default deduction of 0.017 tCO_2e per unit shall be applied for each new thermal device (e.g., biogas stove).

$$LE_{Embodied,\text{thermal},total} = N_{disseminated,y} \times 0.017 \quad \text{Eq. 36}$$

Where,

$LE_{Embodied,\text{thermal},total}$ = Total embodied emissions for the batch of new thermal devices

$N_{disseminated,y}$ = Number of new activity technology units disseminated in year y

0.017 = Default embodied emissions factor (tCO_2e/unit)

9.3.5 **Amortisation of Embodied Emissions:** To align with the physical depreciation of durable assets and ensure cross-methodology consistency, the activity developer shall apply one of two amortization pathways for the total calculated embodied emissions ($LE_{Embodied,digester,total}$) and $LE_{Embodied,\text{thermal},total}$), contingent upon the verifiable technical lifetime of the activity device(s):

a. **Pathway 1: Short-Lived Technologies (Technical Lifetime < 5 years)**: The total embodied emissions shall be deducted entirely upfront from the credits issued during the first monitoring period for that specific unit.

b. **Pathway 2: Durable Technologies (Technical Lifetime ≥ 5 years):** The total embodied emissions shall be annualized (distributed evenly) over the duration of the First Crediting Period (5 years). $LE_{Embodied,y} =$ = Total Embodied Emissions / 5.

c. **Mandatory True-Up Provision:** If an activity utilizing Pathway 2 ceases verification or permanently terminates prior to the completion of the 5-year First Crediting Period, the activity developer shall conduct a true-up calculation at the final issuance event. Any remaining unamortized embodied emissions for the active device fleet shall be deducted in full, from the final issuance request to prevent unpaid carbon debt.

9.4 | Net Leakage from Market, Resource, and Environmental Effects ($LE_{NetEffects,y}$):

9.4.1 This category addresses the balance of negative and positive leakage sources identified in Section 5.5.

$$LE_{NetEffects,y} = LE_{resource,y} + LE_{digestate,y} - LE_{positive,y} + LE_{Thermal,y} \quad \text{Eq. 37}$$

Where,

$LE_{resource,y}$ = Leakage from Resource Competition (Negative) (See 9.4.2) tCO_2e/yr

$LE_{digestate,y}$ = Leakage from Downstream Digestate Emissions (Negative) (See 9.4.3) tCO_2e/yr

$LE_{positive,y}$ = Leakage from Fertilizer Substitution (Positive) (See 9.4.4) tCO_2e/yr

$LE_{Thermal,y}$ = Leakage from Thermal Market Effects (Negative) (See 9.4.5) tCO_2e/yr

9.4.2 **Resource Competition (Feedstock) ($LE_{resource,y}$):** If the activity involves co-digestion of organic materials other than manure (e.g., agricultural residues), the risk of diverting this feedstock from competing uses (e.g., fodder, fertiliser) shall be assessed.

a. **Exclusion Criteria (De Minimis):** Leakage may be excluded ($LE_{resource,y} = 0$) ONLY IF the activity developer provides rigorous, verifiable evidence that the feedstock is a genuine waste (e.g., soiled animal bedding, the organic fraction of MSW) that has no competing economic or environmental uses in the local context and would otherwise be discarded or managed as waste.

b. **Quantification:** If the exclusion criteria cannot be met, leakage shall be quantified via a substitution analysis (e.g., calculating the emissions associated with the synthetic fertilizer required to replace the diverted organic matter).

9.4.3 **Downstream Digestate Emissions ($LE_{digestate,y}$):** The storage and handling of digestate pose a significant risk of CH_4 and N_2O emissions. Scientific literature indicates these emissions are systematically underestimated by standard tools. The activity developer shall apply the following mandatory tiered approach:

a. **Tier 1: Verified Best Practice (Exclusion)**

i. **Condition:** The activity provides rigorous practical verification (e.g., documented household training, visual spot checks during monitoring visits, proper system design features like drying beds or soil incorporation protocols) of continuous adherence to Best Management Practices (BMPs) that ensure aerobic conditions (e.g., immediate soil application, active composting, drying) and prevent discharge into natural water bodies. Continuous laboratory testing is not required.

ii. **Result:** CH_4 leakage is deemed to be 0. (Note: N_2O emissions associated with aerobic handling are accounted for as Activity Emissions under Section 3.2 | and are mathematically excluded

from this specific anaerobic leakage penalty to prevent double-counting).

b. **Tier 2: Conservative Default (Mandatory if Tier 1 Fails)**

i. **Condition:** Tier 1 cannot be verified, or the digestate is stored anaerobically (e.g., in open pits).

ii. **Procedure:** Calculate CH_4 emissions using standard approved tools (e.g., TOOL 14).

iii. Apply a mandatory Conservativeness Factor of 2.4 to the result. This factor accounts for underestimated CH_4 and omitted N_2O emissions.

$$LE_{digestate,y} = Calculated\ CH_4\ Emissions\ (tCO_2e) \times 2.4 \quad \text{Eq. 38}$$

c. **Tier 3: Detailed Quantification**

i. **Condition:** The developer opts to conduct detailed, site-specific quantification of both CH_4 and N_2O emissions using scientifically robust measurement techniques.

9.4.4 **Positive Leakage (Fertilizer Substitution) ($LE_{positive,y}$):** If verifiable evidence demonstrates that the utilisation of digestate displaces the use of synthetic fertilizers, the avoided emissions (positive leakage) may be quantified.

$$LE_{positive,y} = Q_{digestate,utilised,y} \times SF_{displaced} \times EF_{sf} \quad \text{Eq. 39}$$

Where,

$Q_{digestate,utilised,y}$	=	Quantity of digestate utilized as fertilizer tonnes/yr
$SF_{displaced}$	=	Amount of synthetic fertiliser displaced per tonne of digestate tonnes SF/tonne digestate
EF_{sf}	=	Emission factor for the production of the synthetic fertiliser tCO_2e/tonne SF

9.4.5 **Thermal Market Effects** ($LE_{Thermal,y}$): This addresses leakage related to the thermal component (e.g., reuse of displaced baseline stoves outside the boundary). If the activity provides biogas cookstoves that displace existing baseline biomass stoves, the risk of those displaced stoves being reused outside the activity boundary shall be mitigated. If the activity developer fails to verifiably document the decommissioning of baseline stoves or fully internalize stacking (via the P-KPT measurement), a mandatory conservative default deduction of 2% (0.02) of the net thermal emission reductions shall be applied as market leakage.

9.5 | Net Leakage Determination

9.5.1 The total leakage LE_y is the sum of $LE_{Embodied,y}$ and $LE_{NetEffects,y}$ (Eq. 32).

9.5.2 **Constraint:** If the calculation of $LE_{neteffects,y}$ (Eq. 37) results in a negative value (i.e., positive leakage $LE_{positive,y}$ exceeds the sum of negative leakage sources), $LE_{neteffects,y}$ shall be conservatively set to 0 in the final calculation of LE_y. Total Leakage (LE_y) cannot be negative. Furthermore, positive leakage ($LE_{positive,y}$) shall only be used to offset market, resource, and environmental leakage; it shall not be used to offset or cancel out Embodied Emissions ($LE_{Embodied,y}$).

10| NET GHG EMISSION REDUCTIONS

10.1 | Calculation of net GHG emission reductions

10.1.1 The Net Emission Reductions (ER_y) are the final result of the quantification process, representing the total mitigation achieved by the activity after accounting for activity emissions, leakage, and necessary adjustments for behavioural effects during monitoring.

10.1.2 **Net Emission Reductions Equation:** The calculation combines the emission reductions achieved from the AWMS component and the Thermal Application component, adjusts the thermal component for the Hawthorne Effect (if applicable), and subtracts total leakage emissions.

$$ER_y = \left(BE_{AWMS,y} - AE_{AWMS,y}\right) + \left((BE_{TA,y} - AE_{TA,y}) \times HE_{ind}\right) - LE_y$$

Eq. 40

Where:

ER_y	=	Net GHG Emission Reductions in year y (tCO_2e/yr)
$BE_{AWMS,y}$	=	Crediting Baseline Emissions (AWMS component) in year y (tCO_2e/yr)
$AE_{AWMS,y}$	=	Activity Emissions (AWMS component) in year y (tCO_2e/yr)
$BE_{TA,y}$	=	Crediting Baseline Emissions (Thermal component) in year y (tCO_2e/yr)
$AE_{TA,y}$	=	Activity Emissions (Thermal component) in year y (tCO_2e/yr)
HE_{ind}	=	Adjustment index for the Hawthorne Effect (%)
LE_y	=	Total Net Leakage Emissions in year y (tCO_2e/yr)

10.1.3 **Constraint on Leakage:** If the calculated Total Net Leakage (LE_y) is less than 0 (as constrained by Section 9.5), LE_y shall be set to 0 in Eq. 40. Total Leakage cannot be mathematically negative.

10.1.4 **Adjustment for Hawthorne Effect (HE_{ind})** To account for the potential bias where end-users may temporarily alter or artificially inflate their clean device

usage behaviour during the P-KPT observation period or manual surveys (the Hawthorne Effect or social desirability bias), an adjustment index (HE_{ind}) shall be applied to the calculation of Net Emission Reductions generated by the Thermal Application component.

10.1.4.1 | **Applicability Exceptions:** The Hawthorne Effect adjustment applies strictly to Thermal Method 1 (Non-Metered) where fuel consumption is derived from short-term manual observation. For activities applying Thermal Method 2 (Metered Biogas), or for non-cooking appliances (e.g., biogas refrigerators, space heaters) where usage is not subject to manual short-term observation bias, the parameter HE_{ind} shall be set to 1.0.

10.1.4.2 | **Phased implementation and review mechanism:** The application of the Hawthorne Effect adjustment index follows a phased implementation schedule designed to encourage the market's transition toward objective digital monitoring. The default values listed in the table below shall apply for each respective phase.

Table 8: Phased Default Adjustment Factors for Hawthorne Effect

Phase	Applicable Vintage	Default Factor ($HE_{default}$)
Phase 1	2026 & 2027	0.90
Phase 2	2028 & 2029	0.85
Phase 3	2030 or after	0.75

10.1.4.3 | **Condition for Revision[8]:** The scheduled escalations to Phase 2 and Phase 3 represent conservative safeguards. The Secretariat shall conduct a formal review of the latest peer-reviewed empirical evidence (e.g., paired continuous monitor vs. manual survey studies) by June 2027, prior to the activation of Phase 2. If definitive scientific consensus demonstrates a lower magnitude of observer bias in modern contexts, the default factors shall be adjusted accordingly via a methodology update. Absent such peer-reviewed consensus, the scheduled defaults in Table 8 shall automatically apply.

10.1.5 **Determination of HE_{ind}:** The activity developer shall determine the HE_{ind} using one of the following three options:

10.1.5.1 | **Option 1: Default Adjustment:** If the activity measures fuel consumption through P-KPTs and usage surveys only (without continuous Stove Use

[8] The Secretariat invites activity developers, researchers, and stakeholders to submit actual observation data (e.g., paired studies using SUMs and KPTs) and peer-reviewed literature regarding the magnitude of the Hawthorne effect. The Secretariat invites interest from activity developers for discussion on such studies during Phase 1.

Monitors - SUMs), the default adjustment index corresponding to the Phase (as defined in Table 8) shall be applied. Where $HE_{ind} = HE_{default}$

10.1.5.2 | **Option 2: SUMs-based Adjustment:** If the activity complements P-KPTs with SUMs measurements to quantify the magnitude of the Hawthorne Effect, the adjustment index is calculated based on the ratio of usage during a normal monitoring period compared to usage during the P-KPT period. Rigorous protocols for SUMs deployment and data analysis (meeting 90/10 precision) shall be followed.

$$HE_{ind} = \text{MIN}(1, PTC_m / PTC_{KPT}) \qquad \text{Eq. 41}$$

Where,

PTC_m = Average activity technology cooking events per day over 1 month from SUMs measurements.

PTC_{KPT} = Average activity technology cooking events per day over the activity P-KPT period.

10.1.5.3 | **Option 3: Digital MRV / Continuous Sensor Exemption:** Activities quantifying long-term usage via Continuous Stove Monitors (SUMs) or robust Digital MRV (dMRV) systems are exempt from the Hawthorne Effect penalty (HE_{ind} = 1.0). This exemption applies ONLY IF the continuous monitoring covers a statistically representative sample (meeting the 90/10 rule) and is deployed contiguous to, and directly overlapping with, the physical P-KPT measurement period, or if the activity relies entirely on continuous monitoring for crediting.

11| MEETING METHODOLOGICAL PRINCIPLES

11.1 | Encouraging ambition over time

11.1.1 Mandatory Downward Adjustment Factor (DAF) ensures that the crediting baseline is set below the conservative Business-as-Usual (BAU) scenario and aligned with the host country's Net-Zero trajectory.

11.1.2 Dynamic Baseline Parameters: Parameters subject to change, such as the fraction of non-renewable biomass (fNRB), are updated at the renewal of the crediting period (Section 17.3 |), reflecting evolving national circumstances and decarbonisation progress.

11.1.3 Technology Improvement mandate the use of comparable or better technology upon replacement fostering continuous improvement in performance. For mature, long-running programmes operating in vulnerable contexts where further fuel switching is not technically or economically feasible, ambition may also be demonstrated through measurable continuous improvement in performance, device durability, maintenance systems, and sustained usage.

11.2 | Equitable sharing of mitigation benefits

11.2.1 The methodology promotes the equitable sharing of benefits by operating under the GS4GG Community Services Activity (CSA) Requirements.

11.2.1.1 |Activity Scope: The methodology is applicable to decentralized activities (households, small farms, institutions), directly benefiting local communities through improved waste management, access to renewable energy (biogas), and enhanced agricultural productivity from digestate utilisation.

11.2.1.2 |Stakeholder Consultation: Adherence to the GS4GG Principles and Requirements mandates inclusive stakeholder consultation and grievance mechanisms, ensuring local communities participate in and benefit from the activity.

11.2.1.3 |SDG Contributions: The methodology inherently contributes to multiple SDGs (e.g., SDG 7, SDG 13, SDG 3), enhancing the overall welfare and resilience of participating communities.

11.3 | Avoidance of double counting

11.3.1 **Unique Identification:** Requires that all activity units are identified with a unique physical or robust digital identifier and tracked in a centralized activity database (Section 3.2 |).

11.3.2 **Ownership Communication:** Mandates clear communication of ownership rights the collection of verifiable Informed Consent from all participants and end-users.

11.3.3 **Exclusion Criteria:** Explicitly excludes any devices included in other voluntary market, PACM, or CDM activities and mandates comprehensive overlap assessments against Jurisdictional REDD+ programmes (verified via publicly available registries or documentation from the relevant authority) and Safe Water Supply activities (Section 3.2 |).

11.4 | Aligning with NDC and LT-LEDS

11.4.1 **Lock-in Risk Assessment:** The Lock-In Risk analysis(Section 6.4 |) demonstrates that biogas technology is compatible with net-zero pathways as it utilises waste streams for renewable energy and supports sustainable agriculture, aligning with common strategies in NDCs and LT-LEDS.

11.4.2 **Regulatory Compliance:** The requirement for Regulatory Surplus Analysis (Section 6.3 |) ensures the activity goes beyond existing mandates.

11.4.3 **DAF Alignment:** The DAF mechanism is directly linked to the host country's Net-Zero trajectory.

11.5 | Encouraging Broad Participation

11.5.1 **Scalability:** Applicable across Micro, Small, and Large scales, and allows for progressive implementation.

11.5.2 **Tiered Approaches:** The inclusion of both IPCC Tier 1 and Tier 2 approaches for AWMS, and Metered/Non-Metered options for Thermal Application, provides flexibility based on data availability and activity scale, reducing barriers while maintaining rigor.

11.6 | Including Data Sources, Accounting for Uncertainty, and Monitoring

11.6.1 **Data Sources**: Prioritizes the use of recognized, high-quality data sources (e.g., IPCC defaults, standardized tools for fNRB).

11.6.2 **Uncertainty Management**: Mandates a systematic approach to uncertainty (Section 13|), including the application of the 90/10 rule for sampled parameters.

11.6.3 **Conservative Defaults**: Utilizes conservative defaults where site-specific measurement is impractical (e.g., Embodied Emissions, Leakage multipliers for digestate, Hawthorne Effect adjustment).

11.7 | Taking into Account Policies, Measures, and Relevant Circumstances

11.7.1 **Regulatory Framework:** The Regulatory Surplus Analysis (Section 6.3 |) ensures that the impact of national and local policies is considered in determining additionality, including the critical distinction between planned policies and their "de facto" implementation on the ground.

11.7.2 **Context-Specific Baseline:** The requirement for a detailed Baseline Scenario Survey ensures that the baseline reflects the specific local context regarding waste management practices, fuel availability, and socioeconomic conditions.

12| REVERSALS

12.1 | Assessment of Reversal Risks

12.1.1 The activity comprises two distinct mitigation components, each possessing different characteristics regarding the risk of non-permanence (reversal). The activity developer shall assess reversal risks based on the specific component(s) implemented.

a. The Methane Avoidance (AWMS) component involves no risk of reversal, and no further assessment or mitigation measures are required for this component.

b. While the avoidance of the specific combustion event is immediate and permanent, the biomass stocks preserved by the activity remain subject to potential future depletion due to natural disturbances (e.g., fires, pests) or anthropogenic drivers (e.g., land clearance). This represents a potential macro-risk of the loss of preserved carbon stock over time.

12.1.2 In the context of community service activities, the activity developer operates the technology distribution and data management infrastructure but possesses no legal control, land tenure, or management authority over the physical greenhouse gas reservoir (the forest or land area) where the biomass is preserved. Because the mitigation outcome is generated via the avoidance of emissions (not the sequestration or removal of carbon), the physical reversal of credited mitigation outcomes is structurally impossible. Consequently, the activity is formally classified under the "No Control" exemption. Non-permanence buffer pool deductions are structurally inappropriate for avoidance activities operating under this exemption and shall not be required.

12.2 | Mitigation and Management of Reversal Risks

12.2.1 Pursuant to the "No Control" status of the activity developer over the reservoir, this methodology applies an alternative approach to address non-permanence risk through dynamic monitoring and periodic reassessment, with any necessary adjustments applied to subsequent crediting periods.

12.2.2 The following management approach shall be applied at the periodic update (Section 17|):

a. **Dynamic fNRB Updating:** The fraction of non-renewable biomass ($fNRB_y$) parameter shall be periodically updated utilizing the latest versions of approved standardized science-based tools (e.g., MoFuSS or A6.4 fNRB Tool – default values) to accurately reflect the current physical reality of the biomass reservoir. The updated $fNRBy$ value shall be applied to the subsequent crediting period. If the updated fNRB value decreases, the lower value shall be applied without further justification. If the updated fNRB value increases, the activity developer shall justify the continued use of the higher value by demonstrating that users still source wood from the same area.

b. **Catastrophic Disturbance Check:** The activity developer shall conduct an assessment review of the biomass supply area using available evidence (e.g., satellite data assessment, government forestry reports). If Catastrophic disturbance Events (e.g., severe wildfires, large-scale pest outbreaks, or rapid mass land-use conversion to agriculture/urbanization) have occurred since the last assessment.

c. **Baseline Validation:** If the assessment confirms that the historic woody biomass resource is no longer physically available or accessible

to the target population due to severe depletion, the activity developer shall empirically demonstrate (via an updated baseline survey) the actual alternative fuels the population has been forced to adopt (e.g., renewable agricultural residues, dung, or fossil fuels). The baseline scenario shall be formally updated to reflect these alternative fuels, thereby organically adjusting the crediting baseline to match post-disturbance realities and preventing over-crediting for non-existent resources.

12.3 | Addressing Reversals

12.3.1 As the Methane Avoidance component carries no reversal risk, and the risk of macro level non-permanence for the Thermal Application component is addressed ex-ante for future crediting periods via the dynamic updating of the fNRB and baseline fuel scenario, retrospective cancellation of credits or contributions to a Reversal Risk Buffer Pool are not required for this methodology.

13| UNCERTAINTY QUANTIFICATION

13.1 | Approach to Uncertainty Management

13.1.1 The methodology employs a conservative approach to manage uncertainty, ensuring that the estimation of net GHG emission reductions is not overestimated. This is achieved through a systematic application of statistical adjustments, conservative defaults, and robust monitoring requirements.

13.1.1.1 | **Distinction between Statistical Uncertainty and Ambition Adjustments:** The management of statistical and measurement uncertainty detailed in this section corrects exclusively for empirical sampling variance. It is structurally distinct from, and applied prior to, the DAF. The application of a statistical uncertainty adjustment (e.g., LB_{90}) does not exempt the activity from the mandatory application of the DAF, which addresses macroeconomic policy ambition and Net-Zero alignment.

13.1.1.2 | **Statistical Adjustment (90/10 Rule):** Uncertainty associated with parameters determined through sampling is addressed using the 90/10 rule. If the required precision (90% confidence level and 10% margin of error) is not met and additional sampling is not undertaken the methodology mandates the use of the conservative bound of the one-sided 90% confidence interval for the overall weighted parameter:

a. Lower Bound (LB_{90}) for parameters that increase the baseline (Sections 7.4.1.3 |).

b. Upper Bound (UB_{90}) for parameters that increase activity emissions (Section 8.2.5.1 |).

13.1.2 **Conservative Defaults and Factors:** The methodology utilises conservative default values derived from recognised sources (e.g., IPCC) or peer-reviewed literature where site-specific measurement is impractical or to correct for known biases. Key examples include:

a. **Model Uncertainty:** IPCC Model Correction Factors (UF_b) for AWMS calculations (Section 7.3).

b. **Physical Leakage:** Default physical leakage rate (10%) for AWMS (Section 8.2.1.1), applicable unless rigorous, VVB-verified continuous monitoring (e.g., smart meters, TOOL14) is implemented.

c. **Embodied Emissions:** Conservative defaults based on LCA literature (Section 9.3), with an explicit pathway for activity-specific verified LCAs.

d. **Digestate Leakage:** The mandatory 2.4x multiplier if best practices are not verified, correcting for underestimation in standard tools (Section 9.4.2).

e. **Hawthorne Effect:** The default 0.9 adjustment factor (phase 1) for KPT-based monitoring (Section 10.1), unless explicitly exempted via continuous digital monitoring (dMRV).

13.1.3 **Transparency:** All assumptions, data sources, calculations, and uncertainty analyses shall be documented transparently in the PDD and Monitoring Reports.

13.2 | Sources of Uncertainty and Mitigation

13.2.1 Key uncertainty sources and their mandated mitigation measures are summarized in the following table. This matrix shall serve as the normative reference for Validation and Verification Bodies (VVBs) when auditing uncertainty.

Table 9: Key uncertainty sources and mitigation measures

Component	Parameter/ Source of Uncertainty	Potential Impact on ERs	Mitigation Measure Employed
AWMS (Baseline)	Livestock population (N_{LT}) and characteristics (VS, B_o).	Overestimation of baseline CH_4.	Sampling required; 90/10 rule applied (use LB90 if failed). Use of conservative IPCC/national data. Direct farm-level records may substitute for sampling where robust.

	Baseline management practices (MS%) and conditions (MCF).	Overestimation of baseline CH_4.	Determined via Baseline Survey. Use of conservative IPCC defaults for MCF.
	Model uncertainty (IPCC Tier 1/2).	Inaccuracy of the emission model.	Application of mandatory IPCC Model Correction Factors (UFb).
AWMS (Activity/Leakage)	Physical leakage rate ($AE_{PL,y}$).	Underestimation of activity emissions.	Conservative default (10%) applied unless measured rigorously e.g., via smart meters or TOOL14).
	Digestate emissions ($LE_{digestate,y}$).	Underestimation of leakage.	Tiered approach: Practical Verification of BMPs (aerobic handling/no discharge) or application of conservative 2.4x multiplier (Section 9.4.2).
Thermal (Baseline)	Baseline fuel consumption ($P_{b,mean}$).	Overestimation of baseline emissions.	KPT required (90/10 rule applied - use LB_{90} if failed) or use of conservative defaults. Capping of high values. Mandatory scaling using baseline household size (HN_b) and capping of high values (Section 7.4.4).
	Fraction of Non-Renewable Biomass (fNRB).	Overestimation of baseline CO_2.	Use of standardised tools (e.g., MoFuSS, A6.4 Tool Default Value) with the latest available data.
Thermal (Activity)	Activity fuel consumption ($P_{p,mean}$) (Method 1).	Underestimation of activity emissions (from stacking).	P-KPT required (90/10 rule applied - use UB_{90} if failed). 90/10 requirement applies to the overall weighted parameter across cohorts. Mandatory internalisation of stacked baseline stove fuel use.

	Hawthorne Effect (Method 1).	Overestimation of ERs due to observation bias during KPT.	Mandatory phased adjustment factor (0.9 default or SUMs-based) (Section 10.1.4). Continuous digital monitoring (dMRV) is strictly exempt.
	Usage Rate ($U_{p,y}$).	Overestimation of operational days.	Monitored via representative sampling (Usage Surveys). 90/10- rule applied
General	Measurement error (meters, scales).	Inaccuracy of input data.	Requirement for QA/QC procedures, including mandatory pre- and post-deployment calibration checks and mathematical drift correction protocols (Section 14.4 |).
	Embodied Emissions.	Underestimation of leakage.	Application of conservative defaults based on LCA literature (Section 9.3 |) or independent third-party verified LCAs.

14| MONITORING METHODOLOGY

14.1 | Requirements

14.1.1 The activity developer shall develop and implement a comprehensive Monitoring Plan, detailed in the PDD/VPA-DD, covering all aspects of data collection, management, and quality assurance.

14.1.2 **Protocols for Field Tests and Surveys**: Baseline Surveys (BSS), Kitchen Performance Tests (B-KPT, P-KPT), and Usage Surveys shall be conducted following recognised international or national protocols. Activity developers shall apply the latest recognised version of the Kitchen Performance Test (KPT) Protocol (e.g., Clean Cooking Alliance protocol) and adhere to best practices for survey design and implementation. The specific protocols used and detailed procedures shall be documented in the Monitoring Plan. To ensure precise demographic and weather matching, the Baseline KPT (B-KPT) may be conducted concurrently with the initial Project KPT (P-KPT) prior to the first verification.

14.1.3 **Timing and Seasonality of KPTs:** KPTs are not restricted to the end of the monitoring period and may be conducted at any representative time within the monitoring period. If seasonal variations (e.g., wet vs. dry seasons)

materially impact fuel use, the KPT sampling shall be staggered or mathematically weighted to accurately account for both seasons.

14.1.4 **Statistical Requirements (90/10 Rule):** Unless otherwise specified, parameters determined through sampling shall aim to achieve a 90% confidence level and 10% margin of error (90/10 rule). If this precision is not met, the conservative adjustments detailed in Sections 7.4.1. and 8.2.5.1 |. shall be applied. For parameters stratified by age cohort (e.g., $P_{p,mean}$ and $U_{p,y}$), the 90/10 precision target applies to the overall weighted parameter. While sampling shall be stratified by age cohort, 90/10 precision is not strictly required independently within each sub-cohort.

14.1.5 **Digital Monitoring and GDPR Compliance:** The utilization of continuous Digital MRV (dMRV) is highly encouraged and explicitly exempts the activity from the Hawthorne Effect penalty (See Section 10.1.4). To comply with the General Data Protection Regulation (GDPR) and local privacy laws, the mandatory activity database tracking is not required to publish precise household-level GPS coordinates. Geolocation may be logged at the lowest permissible administrative unit (e.g., village or ward), provided unique physical or digital device identifiers rigorously prevent double counting.

14.1.6 **Intermediate Calculation Variables:** For clarity and transparency, parameters derived purely from mathematical or statistical adjustments dictated by the methodology equations do not possess standalone monitoring parameter tables. Their values are structurally dependent on the monitored input parameters and shall be explicitly displayed in the step-by-step mathematical flow of the Emission Reduction calculation spreadsheet.

14.2 | Data and parameters not monitored

14.2.1 The following parameters are determined ex-ante (at the time of validation or renewal of the crediting period) and are not monitored during the crediting period.

General Parameters

Parameter ID	**BGTA 1**
Data/parameter:	Regulatory Framework analysis
Description	National, regional, and local regulatory framework for animal waste management and thermal energy services
Data unit:	N/A
Purpose of data:	☒ Applicability and Additionality (Regulatory Surplus)
Value(s) applied:	N/A
Source of data:	☐ Measured ☒ Other source Official government publications, legal documents

Choice of data or measurement methods and procedures:	Desk review of applicable laws, regulations, and mandates. Used for Regulatory Surplus Analysis (Section 6.3 |). Once at Validation, updated at Renewal. Exemptions: The activity developer may submit credible evidence demonstrating de facto systemic non-compliance or a lack of operational funding/enforcement for specific policies to maintain additionality (except in high-income countries).
Treatment of uncertainty	N/A
Comments:	Used to demonstrate compliance with Safeguard 3.3.2, Additionality (Regulatory Surplus). VVB shall verify the accuracy and completeness of the review, including assessing evidence regarding the "de facto" enforcement of documented mandates (Section 6.3 |)

Parameter ID	**BGTA 2**
Data/parameter:	Technical Life of technology
Description	Average time for which the activity technology (biodigesters and thermal devices) may continue to be operated safely and efficiently.
Data unit:	Years
Purpose of data:	☒ Activity emissions calculation ☒ Safeguarding and Amortisation
Value(s) applied:	N/A
Source of data:	☐ Measured ☒ Other source Manufacturer specifications, independent study report, or standardised durability tests.
Choice of data or measurement methods and procedures:	Used to determine the maximum crediting period and the need for replacement measures (Section 3.2.8). **Requirement:** The technical life of the activity technology shall be fixed and recorded at the time of registration or distribution. **Acceptable Data Sources for Technical Life:** Any of the following sources shall be used: a. Manufacturer specifications; b. Certification by a national standards body (or an appropriate party recognised by one); c. Commercial guarantee or a guarantee from the installer; d. Simulation modelling may be used in conjunction with such field reports. e. For artisanal built-on-site systems (e.g., brick digesters), internal longitudinal field monitoring reports generated by the activity developer from previous deployments of the identical

	technology design are acceptable, subject to VVB verification. Note: Professional or expert opinion is not accepted as a source for this parameter.
Treatment of uncertainty	N/A
Comments:	VVB shall verify the source and appropriateness of the lifetime claimed. This parameter explicitly dictates whether Embodied Emissions shall be deducted entirely upfront (<5 years) or amortised over up to 5 years (≥5 years) as per Section 9.3 |

Parameter ID	**BGTA 3**
Data/parameter:	$DAF_{NetZero}$ (Downward Adjustment Factor)
Description	Factor applied to baseline emissions to encourage increasing ambition over time, aligned with the host country's Net-Zero Target, official NDCs, or the Gold Standard classification framework.
Data unit:	Fraction (%)
Purpose of data:	☒ Baseline emissions
Value(s) applied:	Sourced from GS4GG Tool.
Source of data:	☒ Other source GS4GG Methodology Tool: DAF Determination.
Choice of data or measurement methods and procedures:	Determined following the procedures of the DAF Tool, based on the host country context and the activity start date. If a country has no published Net-Zero trajectory, the default fallback DAF provided in the tool shall be applied. It is applied as a fixed, adjustment coefficient for the specific vintage and does not compound annually.
Treatment of uncertainty	N/A (Standardised Tool).
Comments:	Mandatory application as per Section 7.4.5. Fixed for the crediting period.

Parameter ID	**BGTA 4**
Data/parameter:	T_{avg}
Description	Annual average temperature at the activity site.
Data unit:	°C
Purpose of data:	☒ Baseline emissions
Value(s) applied:	As per activity location(s)

Source of data:	☒ Other source Once at Validation, updated at Renewal.
Choice of data or measurement methods and procedures:	Required if AWMS Method 2 is used (Applicability > 5°C and for MCF selection)
Treatment of uncertainty	N/A
Comments:	VVB shall verify the data source and value.

Parameter ID	**BGTA 5**
Data/parameter:	Indoor air pollution (IAP) Assessment
Description	Evidence demonstrating that IAP levels (PM 2.5 and CO) do not worsen compared to the baseline.
Data unit:	Qualitative / Quantitative emissions tiers
Purpose of data:	☒ Applicability
Value(s) applied:	NA
Source of data:	☒ Other source Manufacturer's test reports (lab or field), standard ISO 19867-1 laboratory test reports, or recent (≤5 years old) published literature/reports by independent agencies. **Exception:** References older than 5 years may be accepted if the activity developer provides a verifiable declaration that the fundamental design, dimensions, and materials of the technology have remained unchanged since the study was published.
Choice of data or measurement methods and procedures:	Submitted once at validation to satisfy Applicability criteria 3.2.
Treatment of uncertainty	N/A
Comments:	Bespoke field emissions monitoring is not required unless transitioning to a completely unventilated technology.

AWMS Component Parameters (Ex-ante)

Parameter ID	**BGTA 6**
Data/parameter:	$N_{LT,mean}$, $N_{LT,adj}$
Description	Mean/Adjusted/annual average number of animals of type LT

Data unit:	numbers
Purpose of data:	☒ Baseline emissions ☒ Activity emissions
Value(s) applied:	As per activity location(s)
Source of data:	☒ Measured ☒ Other source Baseline Scenario Survey (BSS) or robust farm-level operational records.
Choice of data or measurement methods and procedures:	Determined via statistically representative sampling (90/10 rule applies). Once at Validation, updated at Renewal. Adjusted ($N_{LT,adj}$) if 90/10 rule is not met (Section 7.4.1.3]). Direct farm records may substitute sampling where exhaustive data is maintained.
Treatment of uncertainty	N/A
Comments:	Cross-check with official statistics if available. VVB to verify sampling methodology or farm records.

Parameter ID	**BGTA 7**
Data/parameter:	$MS\%_{BL,j}$
Description	Fraction of animal manure handled in baseline system j.
Data unit:	%
Purpose of data:	☒ Baseline emissions ☒ Activity emissions
Value(s) applied:	As per activity location(s)
Source of data:	☒ Measured ☒ Other source BSS or official statistics.
Choice of data or measurement methods and procedures:	Determined via survey assessing baseline manure management practices. Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB to verify survey methodology and results.

Parameter ID	**BGTA 8**
Data/parameter:	VS_{LT}
Description	Volatile solids production per animal of type LT.
Data unit:	kg-dm/animal/yr

Purpose of data:	☒ Baseline emissions ☒ Activity emissions
Value(s) applied:	As per activity location(s)
Source of data:	☒ Measured ☒ Other source Calculated (Eq. 6 or 7) based on BGTA 12/13, or IPCC Volume 4, Chapter 10, (Table 10.13a)/National defaults.
Choice of data or measurement methods and procedures:	Calculated using weight-based or energy intake methods (Section 7.3). Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB to verify calculation and input data sources.

Parameter ID	**BGTA 9**
Data/parameter:	EF_{LT}
Description	Emission factor for direct CH_4 emissions by livestock LT (Method 1).
Data unit:	kg CH_4/kg-dm
Purpose of data:	☒ Baseline emissions
Value(s) applied:	As per activity location(s)
Source of data:	☐ Measured ☒ Other source IPCC 2019 Guidelines (Volume 4, Chapter 10) or national data.
Choice of data or measurement methods and procedures:	Selection based on livestock type and baseline management system. Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB to verify the appropriateness of the selected factor.

Parameter ID	**BGTA 10**
Data/parameter:	B_{0LT}
Description	Maximum methane production potential of VS (Method 2).
Data unit:	m^3 CH_4/kg-dm
Purpose of data:	☒ Baseline emissions ☒ Activity emissions

Value(s) applied:	As per activity location(s)
Source of data:	☐ Measured ☒ Other source IPCC 2019 Guidelines (Volume 4, Chapter 10, (Table 10.16a) or national data.
Choice of data or measurement methods and procedures:	Selection based on livestock type and diet. Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB to verify the appropriateness of the selected factor.

Parameter ID	**BGTA 11**
Data/parameter:	$MCF_{j,k}$
Description	Methane conversion factor for system j in climate region k (Method 2)
Data unit:	%
Purpose of data:	☒ Baseline emissions
Value(s) applied:	As per activity location(s)
Source of data:	☐ Measured ☒ Other source IPCC 2019 Guidelines (Volume 4, Chapter 10, (Table 10.17) or national data.
Choice of data or measurement methods and procedures:	Selection based on baseline management system and local climate data (T_{avg}). Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB to verify the appropriateness of the selected factor and climate data.

Parameter ID	**BGTA 12**
Data/parameter:	TAM_{LT}
Description	Typical animal mass for livestock LT.
Data unit:	kg/animal
Purpose of data:	☒ Baseline emissions
Value(s) applied:	As per activity location(s)

Source of data:	☐ Measured ☒ Other source IPCC defaults or official national/regional livestock census statistics, or peer- reviewed literature
Choice of data or measurement methods and procedures:	Used if calculating VS_{LT} via Eq. 6. Data shall originate from official national livestock census statistics, government publications, peer- reviewed literature, or recognized agricultural research institutions. Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB to verify data source and ensure national data is representative and not selectively chosen to inflate baseline emissions.

Parameter ID	**BGTA 13**
Data/parameter:	$VS_{rate,LT}$
Description	VS excretion rate
Data unit:	kg VS/(1000 kg animal mass)/day.
Purpose of data:	☒ Baseline emissions
Value(s) applied:	As per activity location(s)
Source of data:	☐ Measured ☒ Other source IPCC Volume 4, Chapter 10, (Table 10.13a) or national data.
Choice of data or measurement methods and procedures:	Used if calculating VS_{LT} via Eq. 6. Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB to verify data source.

Thermal Application Component Parameters (Ex-ante)

Parameter ID	**BGTA 14**
Data/parameter:	$P_{b,mean/adj}$
Description	(Mean/Adjusted) Quantity of fuel(s) consumed in baseline scenario b (Method 1).
Data unit:	tonnes/household/day.
Purpose of data:	☒ Baseline emissions

Value(s) applied:	As per activity location(s)
Source of data:	☐ Measured ☒ Other source B-KPT (Option A), Defaults (Option B), or MSL (Option C).
Choice of data or measurement methods and procedures:	Determined via statistically representative B-KPT (90/10 rule applies) or defaults. Adjusted ($P_{b,adj}$) if 90/10 rule not met or MSL used (Section 7.4.1.3 |.). Once at Validation, updated at Renewal.
Treatment of uncertainty	If B-KPT is used, 90/10 precision is required. If failed, the Lower Bound ($P_{b,LB90}$) shall be used.
Comments:	VVB to verify KPT protocol, sampling methodology, and calculations, or the appropriateness of defaults.

Parameter ID	**BGTA 15**
Data/parameter	HN_b
Description	Average number of individuals per household in the baseline scenario.
Data unit:	Persons/households
Purpose of data:	☒ Baseline emissions ☒ SDG baseline Used to mathematically convert measured household-level KPT fuel consumption data into per-capita data to verify against methodological caps (Eq. 4 and Eq. 7).
Value(s) applied:	To be determined at activity level
Source of data:	☒ Measured ☒ Other source Baseline survey or official regional census data matching the target demographic.
Choice of data or measurement methods and procedures:	Determined via statistically representative survey at validation. Updated at Renewal.
Treatment of uncertainty	N/A
Comments:	The ex-ante value shall be structurally validated against the demographic consistency check mandated in Section 7.3.2. Material deviations require downward mathematical adjustment; deviations >20% invalidate the baseline for that cohort.

Parameter ID	**BGTA 16**
Data/parameter:	$\eta_{b,mean/adj}$

Description	(Mean/Adjusted) Thermal efficiency of the baseline device(s) (Method 2).
Data unit:	%.
Purpose of data:	☒ Baseline emissions
Value(s) applied:	As per activity location(s)
Source of data:	☒ Measured ☒ Other source Laboratory tests (WBT/ISO) or conservative global or manufacturer defaults.
Choice of data or measurement methods and procedures:	Determined via statistically representative testing (90/10 rule applies). Adjusted ($\eta_{b,adj}$) if 90/10 rule not met (Section 7.4.1.3 |). Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB to verify test protocols and results.

Parameter ID	**BGTA 17**
Data/parameter:	$\eta_{p,mean/adj}$
Description	(Mean/Adjusted) Thermal efficiency of the activity device(s) (Method 2).
Data unit:	%.
Purpose of data:	☒ Baseline emissions
Value(s) applied:	As per activity location(s)
Source of data:	☒ Measured ☒ Other source Laboratory tests (WBT/ISO).
Choice of data or measurement methods and procedures:	Determined via statistically representative testing (90/10 rule applies). Testing shall be conducted using ISO Standard 19867-1 (latest version) or equivalent national standard. The standalone Water Boiling Test (WBT) protocol may only be used if explicitly mandated by national standards. Activity efficiency for primary biogas stive shall be ≥40%. Adjusted if 90/10 rule not met. Adjusted ($\eta_{p,adj}$) if 90/10 rule not met (Section 7.4.1.3 |). Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB to verify test protocols and results.

Parameter ID	**BGTA 18**
Data/parameter:	$fNRB_{b,y}$
Description	Fraction of non-renewable biomass (Baseline). (fNRB=1 for fossil fuels).
Data unit:	%.
Purpose of data:	☒ Baseline emissions
Value(s) applied:	As per activity location(s)
Source of data:	☐ Measured ☒ Other source MoFuSS, or approved A6.4 tools.
Choice of data or measurement methods and procedures:	Determined using the latest available data and tools for the activity region. Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB shall verify the source and value applied. See Section 12.2 |and 17.3 |for dynamic updating rules in response to permanence/disturbance assessments. If the updated fNRB value decreases, the lower value shall be applied. If the updated value increases, the activity developer shall explicitly justify its continued use by demonstrating users still source wood from the same area.

Parameter ID	**BGTA 19**
Data/parameter:	$NCV_{b,fuel}$
Description	Net calorific value of the baseline fuel(s).
Data unit:	TJ/mass or volume
Purpose of data:	☒ Baseline emissions
Value(s) applied:	As per activity location(s)
Source of data:	☐ Measured ☒ Other source IPCC defaults, national data, or laboratory analysis.
Choice of data or measurement methods and procedures:	Determined based on the specific fuels identified in the BSS. Once at Validation, updated at Renewal.
Treatment of uncertainty	N/A
Comments:	VVB to verify the appropriateness of the values used.

Parameter ID	**BGTA 20**
Data/parameter:	$EF_{b,fCO2}$, $EF_{b,fnonCO2}$
Description	Emission factors (CO_2 and non-CO_2) of baseline fuel f.
Data unit:	tCO_2/TJ, tCO_2e/TJ
Purpose of data:	☒ Baseline emissions ☒ Activity emissions
Value(s) applied:	As per activity location(s)
Source of data:	☐ Measured ☒ Other source
Choice of data or measurement methods and procedures:	Determined based on the specific fuels identified in the BSS. Once at Validation, updated at Renewal. If charcoal is the baseline fuel, the emission factor shall mathematically incorporate the appropriate Wood-to-Charcoal Conversion Factor (WCCF) defaults defined in Section 2| - 6:1 for Sub-Saharan Africa, LDCs; 4:1 for all others. Refer to Annex 2 for applicable values
Treatment of uncertainty	N/A
Comments:	VVB to verify the appropriateness of the values used.

Constants and Defaults

Parameter ID	**BGTA 21**
Data/parameter:	GWP_{CH4}
Description	Global Warming Potential of CH_4.
Data unit:	tCO_2e/tCH_4
Purpose of data:	☒ Baseline emissions
Value(s) applied:	27
Source of data:	☐ Measured ☒ Other source IPCC defaults (AR6).
Choice of data or measurement methods and procedures:	
Treatment of uncertainty	N/A
Comments:	N/A

Parameter ID	**BGTA 22**
Data/parameter:	GWP_{N2O}
Description	Global Warming Potential of N_2O.
Data unit:	tCO_2e/tN_2O
Purpose of data:	☒ Baseline emissions
Value(s) applied:	273
Source of data:	☐ Measured ☒ Other source IPCC defaults (AR6).
Choice of data or measurement methods and procedures:	
Treatment of uncertainty	N/A
Comments:	N/A

Parameter ID	**BGTA 23**
Data/parameter:	UF_b Method 1
Description	Model correction factor (AWMS Method 1).
Data unit:	%
Purpose of data:	☒ Baseline emissions
Value(s) applied:	0.89
Source of data:	☐ Measured ☒ Other source FCCC/SBSTA/2003/10/Add.2
Choice of data or measurement methods and procedures:	
Treatment of uncertainty	N/A
Comments:	N/A

Parameter ID	**BGTA 24**
Data/parameter:	UF_b Method 2
Description	Model correction factor (AWMS Method 1).
Data unit:	%
Purpose of data:	☒ Baseline emissions

Value(s) applied:	0.94
Source of data:	☐ Measured ☒ Other source FCCC/SBSTA/2003/10/Add.2
Choice of data or measurement methods and procedures:	
Treatment of uncertainty	N/A
Comments:	N/A

Parameter ID	**BGTA 25**
Data/parameter:	D_{CH4}
Description	Density of CH_4 (at 20°C and 1 atm).
Data unit:	t/m^3
Purpose of data:	☒ Baseline emissions
Value(s) applied:	0.00067
Source of data:	☐ Measured ☒ Other source Standard scientific values.
Choice of data or measurement methods and procedures:	
Treatment of uncertainty	N/A
Comments:	N/A

Parameter ID	**BGTA 26**
Data/parameter:	NCV_{biogas}
Description	Net calorific value of biogas (Assuming 60% CH_4 content).
Data unit:	GJ/m3
Purpose of data:	☒ Baseline emissions
Value(s) applied:	0.02154
Source of data:	☐ Measured ☒ Other source Standard energy values. May use site-specific NCV if CH_4 content is measured.

Choice of data or measurement methods and procedures:	
Treatment of uncertainty	N/A
Comments:	N/A

Parameter ID	**BGTA 27**
Data/parameter:	$LE_{Embodied,digester,y}$, $LE_{Embodied,thermal,y}$
Description	Default embodied emissions (Household scale biodigester ≤ 20 m³ and thermal device).
Data unit:	tCO_2e/unit
Purpose of data:	☒ Leakage emissions
Value(s) applied:	Digester Default: 2.9 Thermal Device Default: 0.017
Source of data:	☐ Measured ☒ Other source Methodology Default (Section 9.3 |). OR ISO 14040/14044 compliant independent activity specific LCA report.
Choice of data or measurement methods and procedures:	Applied via the applicable full upfront deduction or 5-year amortisation pathway based on technical life (Section 9.3 |).
Treatment of uncertainty	N/A
Comments:	N/A

Parameter ID	**BGTA 28**
Data/parameter:	HE_{ind}/ $HE_{default}$
Description	Phased Hawthorne Effect adjustment index (Thermal Method 1).
Data unit:	Fraction
Purpose of data:	☒ Baseline emissions
Value(s) applied:	Phase 1: 0.90; Phase 2: 0.85; Phase 3: 0.75 (unless using continuous SUMs/dMRV)
Source of data:	☐ Measured ☒ Other source Methodology Default (Section 10.1.4) or empirical SUMs calculation (Section 10.1.5.2 |)

Choice of data or measurement methods and procedures:	VVB verification that the correct HE value has been applied based on the monitoring period year. Strictly exempt ($HE_{ind} = 1$) for Thermal Method 2 (Metered) or if dMRV is utilised.
Treatment of uncertainty	N/A
Comments:	N/A

Parameter ID	**BGTA 29**
Data/parameter:	Digestate CF
Description	Conservativeness Factor for Digestate Leakage (Tier 2).
Data unit:	factor
Purpose of data:	☒ Leakage emissions
Value(s) applied:	2.4
Source of data:	☐ Measured ☒ Other source Methodology Default (Section 9.4.3).
Choice of data or measurement methods and procedures:	
Treatment of uncertainty	N/A
Comments:	N/A

14.3 | Data and parameters monitored

14.3.1 The following parameters shall be monitored ex-post during the crediting period. (Note: In parameter IDs and variables, the subscript "p" denotes the "activity scenario" to maintain structural consistency with legacy carbon accounting formulas).

14.3.2 **General Monitored Parameters**

Parameter ID	**BGTA 30**
Data/parameter:	Activity Database
Description:	Database tracking all activity units (biodigesters and thermal devices)
Data unit:	N/A
Purpose of data:	Applicability, Avoidance of Double Counting.

Measurement and updating frequency	Sales records, installation reports, monitoring surveys. Continuously updated.	
Measurement methods and procedures:	Centralised database including unique physical or robust digital identifier, location, technology type, commissioning date, operational status, and replacement history for every unit deployed. Data Privacy (GDPR Compliance): To comply with data privacy regulations, tracking precise household-level GPS coordinates is not mandatory. Location data may be logged at the lowest legally permissible administrative unit (e.g., village, ward, or point-of-sale district), provided the unique product IDs ensure traceability.	
Entity/person responsible for the measurement:	Activity Developer (or Coordinating/Managing Entity for PoA).	
Measuring instrument(s):	Type of instrument	Computerised database system (e.g., spreadsheet, specialised software).
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures:	Regular internal audits of the database for completeness and accuracy. VVB to audit the database integrity and conduct spot checks during verification. Legacy units distributed under previous methodology versions via retail channels are grandfathered and exempt from retrospective geolocation ID requirements.	
Treatment of uncertainty	N/A (Census).	
Comments:	The database is the foundation for tracking the population and calculating $N_{b,p,y}$	

Parameter ID	**BGTA 31**
Data/parameter:	$N_{b,p,y}$
Description:	Number of activity technology-days.
Data unit:	days
Purpose of data:	Baseline and Activity Emissions

Measurement and updating frequency	Activity Database. Calculated for each Monitoring Period.	
Measurement methods and procedures:	Calculated based on the commissioning/start date and the monitoring period duration for all units identified in the activity Database. **Monthly Batching Simplification:** To simplify calculations for large-scale deployments, developers may treat all units installed within a given calendar month as commissioned on the last day of the month (which is mathematically conservative), provided the assumption is applied symmetrically across the crediting period.	
Entity/person responsible for the measurement:	Activity Developer.	
Measuring instrument(s):	Type of instrument	Computerised database system.
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures:	VVB to verify the calculation methodology based on the database records.	
Treatment of uncertainty	N/A (Calculated based on census data).	
Comments:	Represents the total potential operating time of the disseminated units.	

Parameter ID	**BGTA 32**
Data/parameter:	$U_{p,y}$
Description:	Usage rate of the activity technology.
Data unit:	fraction
Purpose of data:	Baseline and Activity Emissions. (For AWMS and Thermal Method 1. Not applied mathematically to Thermal Method 2 metered biogas to avoid double-discounting).
Measurement and updating frequency	Usage Surveys. Annually or Biennially (via representative sampling).

Measurement methods and procedures:	Determined via statistically representative sampling (Usage Survey) stratified by age cohort. The survey shall assess both the operational status and the frequency of use. **Survey Timing:** The survey shall be conducted within a reasonable timeframe (e.g., up to 6 months *after* the end date of the monitoring period), provided the sample is drawn exclusively from the finalized activity database representing that specific monitoring period. **Cohort Maturity Constraint:** To mitigate the novelty effect, participants in a usage survey with technologies in their first year of use (Age 0-1) shall possess technologies that have been in use on average for at least 0.5 years (6 months). If the monitoring period length precludes this, surveying of those specific units shall be deferred.	
Entity/person responsible for the measurement:	Activity Developer or designated third-party entity.	
Measuring instrument(s):	Type of instrument	Survey instruments (questionnaires), visual inspection.
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures:	Minimum sample size of 50 households per age cohort is strictly required. Training of surveyors. Independent cross-checking of a subset of survey responses. VVB to verify survey methodology, sampling rigor, and results.	
Treatment of uncertainty	90/10 rule applies to the overall weighted usage parameter across cohorts. If precision is not met, the Lower Bound of the 90% CI shall be used.	
Comments:	This factor discounts the emission reductions for units that are no longer operational or used.	

Parameter ID	**BGTA 33**
Data/parameter:	$N_{digester,new,y}$
Description:	Number of new biodigesters installed in year y.
Data unit:	units
Purpose of data:	Leakage

Measurement and updating frequency	Activity Database, Sales/Installation records. Calculated for each Monitoring Period.	
Measurement methods and procedures:	Census of all new biogas units commissioned during the monitoring period, tracked in the Activity Database.	
Entity/person responsible for the measurement:	Activity Developer.	
Measuring instrument(s):	Type of instrument	Database system.
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures:	VVB to verify sales/installation records against the database.	
Treatment of uncertainty	N/A (Census).	
Comments:	Used to apply the one-time or amortised embodied emissions deduction (Section 9.3).	

Parameter ID	**BGTA 34**
Data/parameter:	$N_{Thermal,new,y}$
Description:	Number of new thermal devices installed in year y.
Data unit:	units
Purpose of data:	Leakage
Measurement and updating frequency	Activity Database, Sales/Installation records. Calculated for each Monitoring Period.
Measurement methods and procedures:	Census of all new thermal units commissioned during the monitoring period, tracked in the Activity Database.
Entity/person responsible for the measurement:	Activity Developer.

Measuring instrument(s):	Type of instrument	Database system.
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures:	VVB to verify sales/installation records against the database.	
Treatment of uncertainty	N/A (Census).	
Comments:	Used to apply the one-time or amortised embodied emissions deduction (Section 9.3 |).	

AWMS Component Monitored Parameters

Parameter ID	**BGTA 35**	
Data/parameter:	$MS\%_{p,i}$	
Description:	Fraction of manure handled in activity AWMS i.	
Data unit:	%	
Purpose of data:	Activity Emissions (Calculation of $AE_{PL,y}$).	
Measurement and updating frequency	Annually or biennially.	
Measurement methods and procedures:	Verification that the manure corresponding to $NLT_{,adj}$ is consistently being fed into the activity digester. Determined via survey (household scale) or review of operational logs (large scale).	
Entity/person responsible for the measurement:	Activity Developer or designated field staff/facility operator.	
Measuring instrument(s):	Type of instrument	Survey instruments, operational logs, visual inspection.
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A

QA/QC procedures:	VVB to verify records and conduct spot checks of manure handling practices.
Treatment of uncertainty	If determined by sampling, 90/10 rule applies. If precision is not met, the Upper Bound of the 90% CI shall be used (conservative for Activity Emissions).
Comments:	Ensures the input assumptions for physical leakage calculations remain valid.

Parameter ID	**BGTA 36**	
Data/parameter:	$AE_{power,y}$	
Description:	Data for calculating emissions from operational use of fossil fuel or electricity (e.g., for pumps, mixers).	
Data unit:	kWh, Litres (or other energy unit)	
Purpose of data:	Activity Emissions	
Measurement and updating frequency	Meters, fuel purchase receipts. Monthly (for large scale) or Annually (for small scale).	
Measurement methods and procedures:	Monitoring of energy consumption via meters or tracking fuel consumption via purchase receipts/logs. Calculated using GS TOOL 01 / A6.4-AMT-007.	
Entity/person responsible for the measurement:	Activity Developer or facility operator.	
Measuring instrument(s):	Type of instrument	Electricity meters, fuel flow meters.
	Accuracy class	As per manufacturer specification.
	Calibration requirements	As per manufacturer specification.
	Location	Activity site
QA/QC procedures:	Regular calibration of meters according to manufacturer specifications. VVB to verify receipts, logs, and calculations.	
Treatment of uncertainty	Uncertainty related to meter accuracy addressed through calibration.	
Comments:	Primarily applicable to larger scale or mechanised systems.	

Parameter ID	**BGTA 37**	
Data/parameter:	$AE_{transp,y}$	
Description:	Data for calculating emissions from incremental transport (Method 2).	
Data unit:	km, tonnes, fuel type	
Purpose of data:	Activity Emissions	
Measurement and updating frequency	Transport logs, GPS tracking, vehicle specifications. Monthly or annually.	
Measurement methods and procedures:	Monitoring of transport distances (Dw/res) and quantities (Qy/res) (See Eq. 26). Calculation of incremental distance compared to the baseline.	
Entity/person responsible for the measurement:	Activity Developer or facility operator.	
Measuring instrument(s):	Type of instrument	Odometers, GPS devices, weighbridges.
	Accuracy class	As per relevant standard.
	Calibration requirements	Calibration required for weighbridges.
	Location	Activity site.
QA/QC procedures:	VVB to verify transport logs, weighbridge records, and calculations. Calibration of weighbridges.	
Treatment of uncertainty	N/A (Census of activity).	
Comments:	Applicable only if AWMS Method 2 is used.	

Parameter ID	**BGTA 38**
Data/parameter:	$AE_{storage,y}$
Description:	Data for calculating emissions from pre-digestion storage (Method 2).
Data unit:	days, % dry matter
Purpose of data:	Activity Emissions
Measurement and updating frequency	Operational records, laboratory analysis. Monthly or Annually.

Measurement methods and procedures:	Monitoring storage time (AIl) and analyzing dry matter content to verify if emissions calculation is applicable (Section 8.2. storage >24h AND dry matter < 20%).	
Entity/person responsible for the measurement:	Activity Developer or facility operator.	
Measuring instrument(s):	Type of instrument	Operational logs, laboratory equipment for dry matter analysis.
	Accuracy class	As per lab standards.
	Calibration requirements	As per lab standards.
	Location	Activity site / Lab.
QA/QC procedures:	VVB to verify records and lab results. QA/QC procedures for laboratory analysis following recognized standards.	
Treatment of uncertainty	N/A.	
Comments:	Applicable only if AWMS Method 2 is used and specific conditions are met.	

Thermal Application Component Monitored Parameters

Parameter ID	**BGTA 39**
Data/parameter:	$P_{p,mean/adj}$
Description:	(Mean/Adjusted) Quantity of fuel consumed in activity scenario (Method 1).
Data unit:	tonnes/household/day
Purpose of data:	Activity Emissions
Measurement and updating frequency	Project KPT (P-KPT). Annually or Biennially (via representative sampling).
Measurement methods and procedures:	Determined via statistically representative P-KPT following recognised protocols. The sample shall include devices of varying ages (stratified by age cohorts). **Seasonality Timing:** The P-KPT may be conducted at any representative time within the monitoring period to adequately capture seasonal variations; it is not restricted to the end of the monitoring period. If seasonal variations materially impact fuel use, the KPT sampling shall be staggered or mathematically weighted.

	Stove Stacking Internalisation: The P-KPT physically measures total household fuel consumption, incorporating continued baseline stove use. Fuel consumed by non-activity improved devices shall be measured separately mathematically added to the Activity Emissions or used to proportionally adjust the Baseline Emissions downward to prevent double-claiming.	
Entity/person responsible for the measurement:	Activity Developer or specialized third-party organization.	
Measuring instrument(s):	Type of instrument	Calibrated weighing scales, survey instruments.
	Accuracy class	As per test weights.
	Calibration requirements	Prior to deployment and upon retrieval.
	Location	Households.
QA/QC procedures:	Scales shall be calibrated prior to deployment and upon retrieval. Mathematical drift correction is permitted for calibration errors between 1% and 5% (Section 14.4 |). VVB to verify KPT protocol adherence, sampling rigour, and calculations.	
Treatment of uncertainty	90/10 rule applies to the overall weighted average. If precision is not met, the Upper Bound of the 90% CI shall be used ($Pp, UB90$) (Section 8.2.5.1 |.).	
Comments:	This measurement inherently captures the impact of stove stacking.	

Parameter ID	**BGTA 40**
Data/parameter:	$Q_{biogas,y}$
Description:	Metered volume of biogas used in year y (Method 2).
Data unit:	m^3/yr
Purpose of data:	Baseline Emissions and Activity Emissions
Measurement and updating frequency	Metered volume of biogas used in year y. Continuously (Data downloaded periodically, e.g., monthly/quarterly).
Measurement methods and procedures:	Continuous measurement of biogas consumption (Census) using appropriately installed meters.
Entity/person responsible for	Activity Developer.

the measurement:		
Measuring instrument(s):	Type of instrument	Biogas flow meters (e.g., diaphragm meters, smart meters).
	Accuracy class	As per manufacturer specification.
	Calibration requirements	As per manufacturer specification.
	Location	Households/Facilities.
QA/QC procedures:	Regular calibration and maintenance of meters as per manufacturer specifications. Implementation of procedures for handling data gaps. VVB to verify calibration records and data integrity.	
Treatment of uncertainty	Uncertainty related to meter accuracy addressed through calibration.	
Comments:	Applicable only if Thermal Method 2 is used.	

Parameter ID	**BGTA 41**	
Data/parameter:	$HE_{ind\ data}(PTCm, PTC_{KPT})$	
Description:	Data for calculating Hawthorne Effect adjustment (if Option 2 used).	
Data unit:	events/day	
Purpose of data:	Emission Reductions	
Measurement and updating frequency	Concurrent with P-KPTs (Annually or Biennially).	
Measurement methods and procedures:	SUMs (Stove Use Monitors). Measurement of usage during a normal monitoring period ($PTCm$, minimum 1 month) and concurrently during the KPT period (PTC_{KPT}) using SUMs deployed in the same households undergoing P-KPT. The unobserved period ($PTCm$) shall be contiguous to the P-KPT observation period to ensure seasonal parity.	
Entity/person responsible for the measurement:	Activity Developer or specialised third-party organisation.	
Measuring instrument(s):	Type of instrument	Stove Use Monitors (SUMs) (e.g., temperature loggers).

	Accuracy class	N/A
	Calibration requirements	N/A
	Location	Households
QA/QC procedures:	Proper installation and validation of SUMs performance. VVB to verify SUMs data integrity, placement protocols, and calculations.	
Treatment of uncertainty	90/10 rule applies to the sampling of households for SUMs deployment.	
Comments:	Applicable only if Thermal Method 1 is used AND the SUMs-based adjustment option is selected.	

14.3.3 **Leakage Component Monitored Parameters**

Parameter ID	**BGTA 42**	
Data/parameter:	$LE_{resource,y}$	
Description:	Verification of feedstock source and competing uses (Co-digestion).	
Data unit:	N/A, tonnes (if quantified)	
Purpose of data:	Leakage	
Measurement and updating frequency	Monitoring surveys, operational records, market analysis. Annually or biennially.	
Measurement methods and procedures:	Verification that feedstock meets the exclusion criteria (genuine waste with no competing uses) (Section 9.4.2). If exclusion criteria are not met, data required for substitution analysis shall be collected (e.g., quantity diverted, type of substitute used).	
Entity/person responsible for the measurement:	Activity Developer.	
Measuring instrument(s):	Type of instrument	Survey instruments, operational logs.
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures:	VVB to verify the evidence supporting the exclusion criteria or the data and methodology used for the substitution analysis.	

Treatment of uncertainty	N/A (Verification) or addressed through conservative assumptions in substitution analysis.
Comments:	Only applicable if co-digestion is practiced.

Parameter ID	**BGTA 43**	
Data/parameter:	$LE_{digestate,y}$	
Description:	Verification of Digestate Management Practices (BMPs) (Tier 1) or data for calculation (Tier 2/3).	
Data unit:	N/A (tier 1), tCH_4/tN_2O (Tier 2/3)	
Purpose of data:	Leakage	
Measurement and updating frequency	Monitoring surveys, operational records, field measurements. Annually or Biennially (Tier 1/2). Periodically as defined in the monitoring plan (Tier 3).	
Measurement methods and procedures:	**Tier 1:** Practical verification of aerobic handling (e.g., active composting, drying beds, prompt soil application) and non-discharge into natural waters via monitoring surveys, visual spot checks, and documented user training. Continuous laboratory testing is not required. **Tier 2:** Data required for calculation using CDM TOOL14 (e.g., quantity stored, storage conditions).	
Entity/person responsible for the measurement:	Activity Developer or designated field staff/third party.	
Measuring instrument(s):	Type of instrument	Survey instruments, visual inspection (Tier 1). Gas analysers/chambers (Tier 3).
	Accuracy class	As per instrument standards.
	Calibration requirements	As per instrument standards.
	Location	Activity Site
QA/QC procedures:	VVB to verify evidence of BMPs (Tier 1) or the calculation/measurement procedures (Tier 2/3). Calibration of measurement equipment (Tier 3).	
Treatment of uncertainty	Tier 2: Addressed by mandatory 2.4x Conservativeness Factor.	
Comments:	Crucial parameter. Failure to verify Tier 1 mandates the use of Tier 2 or Tier 3.	

Parameter ID	**BGTA 44**	
Data/parameter:	$LE_{positive,y}$	
Description:	Data for calculating positive leakage from synthetic fertiliser substitution.	
Data unit:	tonnes	
Purpose of data:	Leakage	
Measurement and updating frequency	Annually.	
Measurement methods and procedures:	Monitoring the quantity of digestate utilised as fertiliser ($Q_{digestate,utilized,y}$) and collecting evidence of the amount and type of synthetic fertiliser displaced ($SF_{displaced}$) (Eq. 39). Requires surveying users on their fertilizer use before and after the activity.	
Entity/person responsible for the measurement:	Activity Developer.	
Measuring instrument(s):	Type of instrument	Survey instruments, operational logs, weighbridges.
	Accuracy class	As per relevant standard.
	Calibration requirements	Calibration required for weighbridges.
	Location	Activity site.
QA/QC procedures:	VVB to verify records and the methodology/evidence supporting the displacement claims (e.g., comparison of purchase receipts).	
Treatment of uncertainty	Addressed through conservative assumptions regarding the displacement rate.	
Comments:	Optional. Inclusion requires verifiable evidence of displacement.	

Parameter ID	**BGTA 45**
Data/parameter:	$LE_{thermal,y}$
Description:	Thermal Market Leakage
Data unit:	tCO_2e/yr
Purpose of data:	Leakage
Measurement and updating frequency	Annual (applied dynamically during calculation).

Measurement methods and procedures:	If the P-KPT fails to adequately capture parallel baseline stove use (internalized rebound), a mandatory conservative default deduction of 2% (0.02) of the net thermal emission reductions shall be applied (Section 9.4 l).	
Entity/person responsible for the measurement:	Activity Developer.	
Measuring instrument(s):	Type of instrument	Survey.
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures:	VVB verification of market leakage assumptions and internalisation.	
Treatment of uncertainty	Conservative default applied.	
Comments:	Applicable if Option 2 in Section 9.4.4 is triggered.	

Parameter ID	**BGTA 46**
Data/parameter:	Presence of Stove Stacking
Description:	Qualitative data on the presence and usage practices of baseline and other non-activity technology by activity technology end users.
Data unit:	Fraction (%)
Purpose of data:	Verification of Rebound Internalisation / Market Leakage Assessment
Measurement and updating frequency	Annually (integrated with Usage Survey)
Measurement methods and procedures:	Collected during the Usage Survey (BGTA 32) through in-person interviews or observation. Data collection shall quantify the frequency of usage of both activity and baseline/other devices.
Entity/person responsible for the measurement:	Activity Developer.

Measuring instrument(s):	Type of instrument	Survey
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	Households
QA/QC procedures:	Cross verification against P-KPT data.	
Treatment of uncertainty		
Comments:	Because the total fuel consumed by stacked baseline devices is already fully captured in the physical P-KPT measurement (BGTA 39), the stove stacking fraction calculated here shall NOT be applied as an additional mathematical discount factor in the ER equations, to prevent double-penalizing the activity.	

14.4 | QA/QC and Data Management

14.4.1 **Quality Assurance and Quality Control (QA/QC):** The activity developer shall implement robust QA/QC procedures to ensure the reliability, validity, and integrity of the monitored data.

a. Training: All personnel involved in data collection (e.g., surveyors, field staff) shall be adequately trained on the monitoring protocols, equipment use, and data recording procedures.

b. Data Validation and Cross-Checking: Procedures for data validation shall be implemented, including checks for outliers, inconsistencies, and completeness. Data shall be cross-checked against secondary sources (e.g. national statistics, valid peer reviewed third party studies, previous verification data (limited to a maximum of 3years prior) where available.

14.4.2 **Equipment Calibration and Maintenance:** All measurement equipment (e.g., scales for KPTs, biogas meters, SUMs, laboratory equipment) shall be calibrated and maintained according to the manufacturer's specifications or recognized standards.

a. Physical weighing scales used in field KPTs shall be checked against a standard reference weight prior to deployment and upon retrieval.

b. If the post-deployment check reveals an error of ≤1%, the data is accepted.

c. If the check reveals an error > 1% but ≤ 5%, the recorded data is not discarded; instead, the measured fuel weights shall be mathematically

corrected by applying the exact percentage of the identified variance in the most conservative direction.

d. If the error is > 5%, all data collected since the last successful check shall be strictly excluded from the analysis.

14.4.2.1 | **Independent Review:** It is strongly recommended that key field measurements (e.g., KPTs) and laboratory testing (e.g., thermal efficiency, biogas composition analysis if performed) are conducted by an independent third-party entity with demonstrated expertise.

14.4.2.2 | **Data Storage and Archiving:** All data collected shall be securely stored and archived electronically for the duration of the crediting period plus two (2) years after the final issuance. Storage systems shall comply with applicable General Data Protection Regulation (GDPR) and national data privacy laws, particularly concerning end-user identification and geolocation**.** To comply with data privacy regulations, geographic tracking and database logging may be recorded at the lowest legally permissible administrative unit, provided that unique device identifiers and relational mapping data are robustly maintained and available for VVB verification.

14.4.3 Sampling requirements

14.4.3.1 | **General Requirements:** All sampling efforts shall comply with the requirements of the GS4GG Standard: Sampling and Surveys (or equivalent A6.4/PACM standard). A detailed sampling plan shall be included in the PDD/VPA-DD, specifying the target population, sampling method, sample size calculation, and procedures for sample selection.

14.4.3.2 | **Precision Target (90/10 Rule):** The sampling design shall aim to achieve the 90/10 precision requirement for key parameters (e.g., N_{LT}, P_b, P_p, $U_{p,y}$).

14.4.3.3 | **Uncertainty Adjustment:** If the 90/10 precision target is not met ex-post, the conservative bound of the 90% confidence interval shall be applied as detailed in Sections 7.4.1.3 |. and 8.2.5.1 |.

14.4.3.4 | **Representativeness and Stratification:** The sample shall be representative of the target population. If the population is heterogeneous, stratification shall be used. A minimum sample size of 50 households per age cohort is strictly required.

14.4.3.5 | **Accounting for Performance Degradation:** To account for potential degradation of the thermal device performance over time, the sampling frame for Project KPTs (P-KPT) shall include devices of varying ages, representative of the age distribution of the devices deployed in the activity during the monitoring period. The results of the P-KPT will therefore inherently reflect the average performance of the devices in the field.

15| MONITORING REQUIREMENTS FOR ACTIVITIES WITH REVERSAL RISKS

15.1 | Applicability

15.1.1 As established in Section 12|, this methodology addresses emission avoidance (methane capture/destruction and the displacement of baseline biomass combustion) and does not involve carbon sequestration or storage. Because the mitigation outcome is generated via the avoidance of emissions rather than carbon removals, the physical reversal of credited mitigation outcomes is structurally impossible.

15.1.2 In alignment with the "No Control" exemption regarding the physical biomass reservoir, the activity developer is formally exempt from continuous Reversal Risk monitoring requirements and is not required to contribute to, or monitor, a Reversal Risk Buffer Pool.

15.1.3 The monitoring of activity performance and the risk of micro-level non-permanence of the mitigation activity (e.g., technology failure, abandonment, or discontinuation of use) are addressed strictly through the standard monitoring requirements detailed in Section 14| (e.g., annual Usage Surveys, age-cohort tracking, and P-KPTs).

15.1.4 The risk of macro-level non-permanence (i.e., the regional depletion of the baseline carbon stock due to external factors like agricultural expansion or wildfires) is managed structurally ex-ante. The activity developer shall manage this risk exclusively through the mandatory reassessment of the baseline fuel scenario, the Qualitative Disturbance Check, and the updating of the Fraction of Non-Renewable Biomass ($fNRB_y$) parameter at each crediting period renewal, in strict accordance with the rules established in Section 12.2 and Section 17.

16| APPLICATION TO PROGRAMME OF ACTIVITIES

16.1 | General Requirements

16.1.1 This methodology is applicable to a Programme of Activities (PoA). The implementation of the PoA shall comply with the latest version of the GS4GG Programme of Activities Requirements. The PoA may consist of multiple Voluntary Project Activities (VPAs), implementing anaerobic digestion and biogas utilization measures across a defined geographical boundary.

16.2 | Eligibility Criteria for VPA/CPA Inclusion

16.2.1 The CME shall define clear and objective eligibility criteria in the PoA-DD for the inclusion of VPAs. These criteria shall ensure that each VPA explicitly:

a. **Methodology Compliance:** Meets all applicability conditions of this methodology (Section 3.2 |).

b. **Boundary Definition:** Is located within the geographical boundary defined for the PoA.

c. **Consistency with PoA:** Is consistent with the baseline scenario(s) and additionality demonstration established at the PoA level. The consistency check procedures defined in Section 7.3.2 shall be applied.

d. **Regulatory Surplus:** Complies with local regulations and meets the requirements for Regulatory Surplus (Section 6.3 |), including assessments of de facto enforcement.

e. **Avoidance of Double Counting:** Is not included in any other registered PoA, activity, or mitigation mechanism. The CME shall maintain records and ensure unique digital or physical identification of all units. The VPA shall also comply with the required overlap assessments for Jurisdictional REDD+ and Safe Water Supply activities.

f. **Leakage Mitigation:** Complies with the requirements for digestate management and feedstock sourcing to mitigate leakage risks (Section 9.4 |).

16.3 | Baseline and Additionality Demonstration

16.3.1 Additionality shall be demonstrated at the VPA level. A VPA may utilise the Positive List (Deemed Additionality) defined in Section 6.2 | provided the VPA explicitly meets all geographic, scale, and policy criteria at the time of its inclusion in the PoA.

16.3.1.1 |The baseline scenario(s) shall be determined following the stepwise approach in Section 7.

a. **Scenario Identification:** The baseline scenario(s) may be determined at the PoA level if the baseline conditions (AWMS practices and thermal energy consumption) are demonstrably homogeneous across the programme boundary.

b. **Stratification:** If significant differences in baseline conditions exist, the baseline scenarios shall be determined for distinct groups of VPAs/CPAs or stratified geographical areas. The methodology applied (e.g., AWMS Method 1 vs. 2) may vary between groups, provided applicability conditions are met.

c. **DAF Application:** The Downward Adjustment Factor ($DAF_{NetZero}$) shall be applied at the PoA or VPA/CPA group level, as appropriate, based on the geographical scope and corresponding vintage year.

16.4 | Monitoring and Quantification

16.4.1 **Sampling Approach:** Monitoring of parameters may be conducted using a sampling approach across the PoA to reduce monitoring costs while maintaining accuracy and conservativeness. The sampling approach shall comply with the requirements of the *GS4GG Standard: Sampling and Surveys*.

16.4.2 **Precision Requirements (90/10 Rule):** All sampling conducted to determine key parameters (e.g., $NLT_{LT}, P_b, P_p, U_{p,y}$) shall aim to achieve a 90% confidence interval and 10% margin of error (90/10 rule).

16.4.3 **Uncertainty Adjustment:** If the 90/10 precision target is not met at the PoA or stratum level, the conservative bound of the 90% confidence interval shall be applied, as detailed in Sections 7.4.1(Baseline) and 8.2.5.1 |(Activity).

16.4.4 **Cross-VPA/CPA Sampling and Stratification:** Sampling across multiple VPAs/CPAs is permitted, provided the populations are demonstrably homogeneous with respect to the parameter being monitored. If homogeneity cannot be demonstrated using recognized statistical methods, the population shall be stratified, and sampling shall be conducted independently for each stratum. Cross-VPA sampling is not allowed across groups larger than 10 VPAs, unless specific justification for homogeneity across a larger group is provided and validated by the VVB.

16.4.5 **Sampling Plan:** The sampling plan shall be detailed in the PoA-DD/VPA-DD and validated by the VVB.

16.4.6 **Data Management and QA/QC:** The CME is responsible for establishing and maintaining a comprehensive, centralized data management system. This system shall ensure the robust tracking of all included units, the collection and archiving of monitoring data, implementation of QA/QC procedures (Section 14.4 |), and the accurate calculation of emission reductions for each VPA.

17| RENEWAL OF CREDITING PERIOD

17.1 | Crediting Period Renewal Requirements

17.1.1 The renewal of the crediting period (subsequent to the initial 5-year period) shall be conducted in accordance with the latest version of the GHG Emissions Reduction & Sequestration Product Requirements and the procedures defined in this section. The activity developer shall apply the version of this methodology that is valid at the time of submission for renewal.

17.2 | Reassessment of the Baseline Scenario

17.2.1 The validity of the baseline scenario(s) identified in Section 7.3.1 shall be reassessed to ensure it reflects the conditions prevailing at the time of

renewal. The activity developer shall determine the new baseline scenario following the stepwise approach in Section 7|.

a. **AWMS Baseline Reassessment:** The developer shall assess whether changes in agricultural practices, regulations (e.g., new manure management standards), or market conditions have altered the predominant methods of animal waste management in the target area, independent of the activity.
b. **Thermal Baseline Reassessment:** The developer shall assess changes in energy markets, fuel availability, autonomous technology adoption, and relevant policies that may have altered the baseline thermal energy consumption patterns.

17.3 | Update of Baseline Parameters

17.3.1 All key parameters used for baseline determination shall be updated using data representative of the conditions at the time of renewal.

17.3.2 **Parameters Fixed in the Previous Crediting Period:** Parameters determined ex-ante and fixed for the initial crediting period shall be re-evaluated and updated. This requires conducting new surveys and/or field testing (e.g., KPTs) as necessary. This includes, but is not limited to:

a. **Livestock Data:** Livestock populations (NLT) and characteristics (VS, Bo).
b. **Manure Management Practices:** Baseline manure management systems ($MS\%_{Bl,j}$).
c. **Thermal Fuel Consumption ($P_{b,mean}$):** This shall be updated by conducting new Baseline KPTs (B-KPTs) or applying the latest conservative defaults/MSL valid at the time of renewal.
d. **Technology Efficiencies:** Baseline (η_b) and activity (η_p) technology efficiencies.

17.3.3 **Procedures for Baseline Update in Saturated Activity Areas:** If the activity has achieved high market penetration (e.g., >95%) or total saturation (100%) within the defined activity boundary (e.g., a specific commune or village), identifying a representative sample of baseline technology/practice users internally is not feasible.

17.3.3.1 |In such cases, the baseline fuel consumption ($\boldsymbol{P_{b,mean}}$) and baseline AWMS practices ($MS\%_{Bl,j}$) shall be updated using the hierarchical approach defined below. The activity developer shall justify the selected approach, and the VVB shall validate its appropriateness.

a. **Prohibited Approach: Reversion Testing.** Asking activity participants to revert to using baseline technologies (e.g., reconstructing three-stone fires or draining biodigesters to rebuild open lagoons) for the purpose of baseline testing is strictly prohibited.

b. **Preferred Approach: Identification and Testing of a Proxy Control Group**. The activity developer shall identify a Proxy Control Group located outside the immediate activity boundary that is statistically comparable to the activity population and continues to use the baseline technologies/practices.

a. **Criteria for Proxy Control Group Selection:** The Proxy Control Group shall be comparable in all material aspects that influence fuel consumption and manure management (e.g., socio-economic status, climate, farming practices, livestock types, fuel availability).

b. **Demonstration of Comparability:** The activity developer shall provide a rigorous, quantitative demonstration that the Proxy Control Group is statistically comparable to the activity area as it existed at the start of the preceding crediting period.

c. **Execution:** Once comparability is validated by the VVB, the B-KPT and baseline AWMS survey shall be conducted within the Proxy Control Group, adhering to the 90/10 precision standard.

17.3.3.2 | **Fallback Approach: Conservative Carry-Forward with Autonomous Improvement Factor (AIF).** This approach may only be used if the activity developer provides verifiable evidence that identifying a suitable Proxy Control Group is infeasible. The activity developer may carry forward the Adjusted Baseline Parameters (Pb,adj and $MS\%_{Bl,j}$) established at the start of the previous crediting period. However, these values shall be mathematically adjusted by an Autonomous Improvement Factor (AIF) to conservatively account for improvements in energy efficiency, waste management, or fuel availability that likely would have occurred autonomously over the preceding 5 years.

a. **Application of AIF:** A mandatory, conservative AIF of 5% per 5-year crediting period shall be applied, reducing the baseline emission parameters by 5%.$\boldsymbol{P_{b,mean,renewal}} = P_{b,adj\ Previous\ CP}$ *(1 - 0.05); $MS\%_{Bl,j},renewal = MS\%_{Bl,j,previous\ CP}$, * (1 - 0.05) (applied to the most carbon-intensive baseline practice, shifting the 5% to a lower-emitting practice). Note: If the activity utilized the MSL/Default baseline (Option B or C) in the previous crediting period, this fallback approach (AIF) is not applicable, and the activity shall continue to use the MSL/Default baseline for the renewed period.

17.3.4 **Dynamic Parameters:** Parameters that are subject to frequent change or policy influence shall be updated using the latest available data and tools valid at the time of renewal.

a. **Fraction of Non-Renewable Biomass (fNRB):** The fNRB shall be updated using the latest approved version of the relevant standardised tool (i.e., MoFuSS, TOOL33) and data reflecting current conditions in the host country. In accordance with Section 12.2 |, if a

Catastrophic Disturbance Event has occurred, or if the newly calculated fNRB is mathematically higher than the previous period: If the updated fNRB value decreases, the lower value shall be applied without further justification. If the updated fNRB value increases, the activity developer shall justify the continued use of the higher value by demonstrating that users still source wood from the same area. If depleted, the baseline fuel scenario shall be reset to the actual alternative fuels adopted.

b. **Emission Factors and GWP:** Fuel emission factors (EF), IPCC defaults (e.g., MCF), and Global Warming Potentials (GWP) shall be updated according to the latest applicable requirements and recognised data sources.
c. **Grid Emission Factor:** If applicable (e.g., for $AE_{power,y}$), the grid emission factor shall be updated.
d. **Downward Adjustment Factor (DAF):** The $DAF_{NetZero}$ shall be updated based on the latest version of the GS4GG Methodology Tool: DAF Determination.

17.4 | Reassessment of Additionality

17.4.1 The additionality of the activity shall be reassessed for the renewed crediting period, following the requirements of Section 6.

17.4.1.1 | **Ongoing Financial Need (Mandatory):** The activity developer shall provide robust evidence (e.g., updated financial analysis or funding assessment) demonstrating that the activity continues to require income from carbon credits to remain operational and sustainable (Section 6.8 |).

17.4.1.2 | **Regulatory Surplus:** The Regulatory Surplus Analysis (Section 6.3 |) shall be updated to account for any new laws, regulations, or mandates implemented since the start of the previous crediting period.

17.4.1.3 | **Common Practice Analysis:** The Common Practice Analysis (Section 6.7 |) shall be updated to reflect the current market penetration of the technology in the applicable geographical area, ensuring that technologies funded by carbon markets are explicitly excluded from the penetration calculation.

ANNEX 1 MONITORING SCHEDULE AND REQUIREMENTS

Table A2.1. Default NCVs

Activity/Parameter	Data Collection Method	Data Source/Tool	Required Precision (If sampled)	Frequency
Ex-Ante (Validation/Renewal)				
Baseline Scenario Survey (BSS) (N_{LT}, $MS\%_{Bl}$, Baseline Fuel Mix)	Survey	BSS	90/10 Rule (for NLT)	Once every 5 years
Baseline KPT (B-KPT) ($P_{b,mean}$) (Thermal Method 1, Option A)	Field Test	KPT Protocol	90/10 Rule	Once every 5 years
Efficiency Testing (ηb, ηp) (Thermal Method 2)	Laboratory Test	WBT/ISO Protocol	90/10 Rule	Once every 5 years
f_{NRB} Determination	Desk Study	MoFuSS / A6.4 Tool	N/A	Once every 5 years
DAF Determination	Desk Study	GS4GG DAF Tool	N/A	Once every 5 years
Ex-Post (During Crediting Period)				
Activity Database Update (Nb,p,y, New Units)	Records Review	Sales/Installation Records	Census (N/A)	Continuous /Monthly
Usage Survey (Up,y)	Survey	Usage Survey	90/10 Rule	Annually/Biennially
Activity KPT (P-KPT) ($P_{p,mean}$) (Thermal Method 1)	Field Test	KPT Protocol	90/10 Rule	Annually/Biennially
Hawthorne Effect (HE_{ind}) (Thermal Method 1, Option 2)	Sensor Monitoring	SUMs	90/10 Rule	Concurrent with P-KPT
Metered Biogas Consumption ($Q_{biogas,y}$) (Thermal Method 2)	Metering	Biogas Meters	Census (N/A)	Continuous
Operational Energy Use ($AEpower,y$)	Metering/Records	Meters/Receipts	Census (N/A)	Monthly/Annually
Transport/Storage ($AE_{transp/storage,y}$) (AWMS Method 2)	Records Review	Operational Logs	Census (N/A)	Monthly/Annually

Leakage: Resource Competition ($LE_{Resource,y}$)	Survey/Records	Monitoring Survey	N/A	Annually/Biennially
Leakage: Digestate Management ($LE_{Digestate,y}$)	Survey/Field Test	Monitoring Survey/TOOL14/Measurements	N/A	Annually/Biennially
Leakage: **Fertiliser** Substitution ($LE_{Positive,y}$)	Survey/Records	Monitoring Survey	N/A	Annually

ANNEX 2 STANDARDISED PARAMETERS AND DEFAULTS

This Annex provides standardised default values derived from the latest IPCC guidelines, strict mass-balance derivations, and relevant scientific literature (including CLEAR methodology defaults) to ensure robustness and consistency.

A2.1 | Net Calorific Values (NCVs)

Table A2.2. Default NCVs

Fuel Type	NCV (TJ/tonne)	Source/Notes
Fuelwood (Air-dried)	0.0156	Standard assumption (20% moisture content).
Crop Residues	0.0150	IPCC 2006
Animal Dung	0.0139	IPCC 2006
Charcoal	0.0295	IPCC 2006
Kerosene	0.0438	IPCC 2006
LPG (Liquified Petroleum Gas)	0.0473	IPCC 2006
Coal (Sub-bituminous)	0.0210	IPCC 2006
Ethanol (Bio-ethanol)	0.0268	Assumes 95% ethanol, 5% water.

A2.2 | Combustion Emission Factors (CO_2 and Non-CO_2)

Table A2.2. Default Combustion Emission Factors

Fuel Type	EF_{CO2} (t_{CO2}/TJ)	$EF_{non\text{-}CO2}$ (tCO_2e/TJ) (CH_4 + N_2O)	Notes on Non-CO_2

Fuelwood	112.0	9.46	Based on typical inefficient biomass combustion.
Crop Residues	109.9	6.67	-
Animal Dung	109.2	4.36	-
Charcoal (LMIC default – 6:1 WCCF)	355.36	89.68	Total Lifecycle (Downstream Combustion + Upstream Kiln). Mandatory Default for Sub-Saharan Africa (SSA) and LMICs (approx. 17% kiln efficiency).
Charcoal (Default – 4:1 WCCF)	236.91	61.74	Total Lifecycle (Downstream Combustion + Upstream Kiln). Mandatory Default non LMIC (approx. 25% kiln efficiency) or for developers voluntarily seeking CCP label alignment.
Crop Residue	109.9	6.67	-
Animal dung	109.2	4.36	-
Kerosene	71.5	0.14	-
LPG	63.0	0.08	-
Coal (Sub-bituminous)	96.1	1.96	-
Ethanol	68.9	0.11	-
Biogas	54.5	0.13	Assumes 60% CH_4 content.

(Note: GWPs used for non-CO_2 calculations are based on IPCC AR5 values: CH_4=28, N_2O=265).

A2.3 | Upstream Emission Factors (UEF)

These factors account for emissions during fuel production, processing, and transport.

Table A2.3. Default Upstream Emission Factors

Fuel Type	UEF (tCO_2e/TJ)	Source/Notes (Based on CLEAR/LCA data)
Fuelwood / Crop Residues / Dung	0.0	Assumed negligible for locally collected biomass.
Charcoal	0.0	Set to zero here to prevent double-counting. Upstream kiln emissions (CH_4, N_2O, and CO_2) are strictly integrated into the primary Emission Factors in Table A2.2 to ensure fNRB applies correctly to all upstream wood harvested.

Kerosene	14.0	Lifecycle emissions (extraction, refining, transport).
LPG	14.0	Lifecycle emissions (extraction, refining, transport).
Coal	10.0	Lifecycle emissions (mining, transport).
Ethanol (Bio-ethanol)	[Variable]	Shall be calculated based on feedstock and production process. Cannot be assumed zero unless derived from waste streams with full lifecycle accounting.
Biogas	0.0	Assumed negligible if sourced from waste/manure on-site.

A2.4 | Default Baseline Technology Efficiencies (η_b)

If laboratory testing of baseline devices is not feasible or subject to extreme field variability, the following conservative defaults shall be used as permissible alternatives for Method 1 calculations.

Table A2.4. Default Baseline Efficiencies

Baseline Technology	Fuel	Default Efficiency (η_b)
Three-stone fire or equivalent basic stove	Fuelwood	15%
Traditional metal stove (e.g., Coal Pot)	Charcoal	25%

ANNEX 3 METHODOLOGY-LEVEL ADDITIONALITY AND BARRIER ANALYSIS FOR DECENTRALIZED ENERGY ACTIVITIES

Refer to Annex - 4 of Reduced emissions from cooking and heating.

DOCUMENT INFORMATION

VERSION	DATE	DESCRIPTION
2.0	05/05/2026	Update to align with Paris Agreement.
1.1	25/01/2023	Editorial corrections
1.0	19/10/2022	Initial adoption

Published by Gold Standard

Contact Details

The Gold Standard Foundation
International Environment House 2
Chemin de Balexert 7-9
1219 Châtelaine Geneva, Switzerland
Tel +41 22 788 70 80
Email help@goldstandard.org