Verified Carbon Standard

VCS Tool

VT001X

LONG-TERM AVERAGE TOOL

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Sectoral Scope 14: Agriculture, Forestry, and Other Land Use (AFOLU)

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1 SUMMARY DESCRIPTION

The long-term average (LTA) is a calculation that estimates the average carbon storage at the end of the crediting period within the project area when harvesting activities are likely to be included as part of the project activity. It sets the maximum credit issuance per stratum and ensures that greenhouse gas (GHG) credits reflect the carbon that a project stores over time and helps avoid over-crediting. The *VCS Standard* requires proponents of Afforestation, Reforestation, and Revegetation (ARR) and Improved Forest Management (IFM) projects to apply a tool for calculating the LTA of forest carbon stocks at validation and at crediting period renewal.[1] The LTA Tool described here, including the associated LTA calculation spreadsheet, is that calculation instrument.

The LTA accounts for changes in carbon storage, due to growth and harvest, and provides an average across a minimum of 40 years, equivalent to the project longevity period. Where the minimum period of 40 years (or the project crediting period, if longer) is not a whole number of complete harvesting cycles, the LTA period must be extended to the next whole number of complete harvesting cycles (e.g., 45 years for a nine-year harvesting cycle, being five complete cycles).

The LTA Tool has two parts. First, it uses a risk-based approach assessing the likelihood of harvest based on project activities and context to determine whether an LTA is required for each stratum or for the project area as a whole. Then, it provides the procedure for calculating the LTA in this document. The *LTA Harvest Risk Assessment and Calculation* spreadsheet (the "LTA calculation spreadsheet" or its digitized version, when available) must be used to apply these requirements consistently. The LTA is calculated in tCO_2e and corresponds to the stratum or project area, depending on the harvest schedule.

This document sets out the requirements and equations for calculating a project's long-term average and provides guidance for using the associated LTA calculation spreadsheet.

2 SOURCES

The tool is based on the following VCS Program documents:

- *VCS Standard, v4.7*
- *AFOLU Non-Permanence Risk Tool v4.2*

[1] In VCS Standard v5.0, this requirement is located in Section 3.2.28.

3 DEFINITIONS

The following definitions apply to this tool and supplement the *VCS Program Definitions.*

Complete harvesting cycle
The complete period from one planting event to the next planting event following harvest on the same area of land. For even-aged management, this is the interval from establishment (e.g., planting) through harvest and subsequent re-establishment. For selective cutting systems, the full harvesting cycle is the allowable re-entry period into the area as specified in the forest management plan.

LTA GHG benefit
The time-averaged GHG benefit a project maintains within a specified area (stratum or project area) over the established time period. It is the maximum quantity of GHG credits the project may be issued over its lifetime.

LTA Carbon stock change
The time-averaged change in carbon stock, which provides the basis for buffer-credit withholding

LTA time period
The number of years (n) over which the LTA is calculated.

Stratum
A homogeneous subgroup of one or more project activity instances, defined for sampling and quantification purposes. Each stratum is grouped based on shared characteristics relevant to carbon stock estimation, such as location, climate, soil type, project intervention, species composition, or start date, and is expected to differ from other strata with respect to one or more of these characteristics.

4 APPLICABILITY CONDITIONS

This tool is applied to calculate the LTA GHG benefits for ARR and IFM activities.

This tool is applicable under any of the following conditions:

1) The applicable methodology requires or permits the use of this tool; or

2) The VCS Program rules and requirements require or permit the use of this tool.

This includes the following methodologies:

- *VM0003 Methodology for Improved Forest Management through Extension of Rotation Age, v1.3*

- *VM0005 Methodology for Conversion of Low-Productive Forest to High-Productive Forest, v1.2*
- *VM0034 Canadian Forest Carbon Offset Methodology, v2.0*
- *VM0045 Improved Forest Management Using Dynamic Matched Baselines from National Forest Inventories, v1.2 and v1.3 (forthcoming)*
- *VM0047 Afforestation, Reforestation, and Revegetation,, v1.0 and v1.1*
- *AR-ACM0003 Afforestation and Reforestation of Lands Except Wetlands, v2.0*
- *AR-AMS0007 Afforestation and Reforestation Project Activities Implemented on Lands Other Than Wetlands, v3.1*

M0274 Enhanced Forest Sequestration with Dynamic Baselines Using Randomized Control Trials (forthcoming)

This tool is not applicable to IFM methodologies that require no planned project harvest. This includes the following methodologies:

- *VM0010 Methodology for Improved Forest Management: Conversion from Logged to Protected Forest*
- *VM0011 Methodology for Calculating GHG Benefits from Preventing Planned Degradation*
- *VM0012 Improved Forest Management in Temperate and Boreal Forests (LtPF)*

3) Where harvest risk is confirmed:

   a. LTA is required for the project, or a stratum within the project. The proponent must apply and report the LTA calculations as part of project documents submissions under the VCS Program.

   b. LTA must be calculated at validation and must be updated at each subsequent verification, according to monitored GHG benefits and eventual changes to the forest management plan, rotation length, or harvesting schedule that affects the LTA.

5 PROCEDURES

The requirements of the tool are set out in this document. The LTA calculation spreadsheet uses a guided sequence of tabs (see Table 1) and must be used to apply these requirements. The Instructions tab is the entry point: project proponents select the applied methodology in this tab, and the spreadsheet will indicate whether the LTA Tool applies and which tabs must be completed.

Table 1. LTA Calculator Overview

Tab	Purpose	Information Required
Instructions	Entry point and methodology setup; determines whether the LTA Tool applies and directs the user to the relevant tabs. Includes key definitions and an explanation regarding the cell-color legend.	Methodology number
Harvest Risk Assessment	Determines, stratum by stratum, whether the project is exposed to harvest risk and therefore whether an LTA applies, returning a final determination supported by an evidence checklist.	Information on project activities and project context from the project design document
Methodology Parameters	Maps each methodology specific parameter and related equations to the generic inputs the calculator expects.	Growth and yield projections, harvest schedule, crediting period length, stratum
LTA Calculator	Computes the LTA from the year-by-year data, reporting the final LTA GHG Benefit and LTA Carbon Stock Change results together with the credit-issuance status.	Credit issuances

5.1 Harvest Risk (HR) Assessment

The HR assessment is the first step of this tool and consists of determining whether an LTA is required on a per stratum basis or, where the project is not stratified, it is applied to the entire project area.

Where the project proponent specifies that harvesting is planned in the project area or stratum, the project proponent does not need to complete the HR assessment (Section 5.1) is not required. The proponent must document the planned harvesting, including the harvest schedule and replanting plan in the forest management plan, and apply the LTA calculation (Sections 5.2 to 5.6) to that stratum.

Where required, the HR assessment must be carried out in accordance with Step 1 below at validation and every verification.[2] The Harvest Risk Assessment tab of the LTA calculation spreadsheet must be used for this purpose.

The inputs for both the assessment and the calculation must be derived from and consistent with the data and information provided in the Project Design Document and any Monitoring Reports.

[2] In *VCS Standard v5* this requirement is located in Section 3.2.28.

More specifically, inputs must include the Forest Management plan which specifies the harvesting and replanting timing for planned planting species and expected wood products.

Step 1: HR assessment

Step 1 determines whether HR is confirmed. It must be completed before any LTA calculation is carried out and it must be repeated at validation and at every verification (see below). The HR assessment must be done for each stratum or for the project area if the project is not stratified.

1.1 Define the strata. Use the strata defined in the applied methodology. Where the project is not stratified, treat the project area as one stratum. Confirm that the project is an ARR or IFM project under a methodology to which this tool applies (Section 4).

1.2 Score the seven HR indicators. For each stratum, select one option for each of the indicators, shown in Table 2. The indicator score equals the score of the selected option; for each indicator, each stratum must be assigned only one value. Where harvest is planned, projected aboveground biomass (AGB) removals must be taken from the harvest schedule in the forest management plan and actual removals from monitoring data.

Table 2. HR indicators and scoring

Indicator	Option (select one per stratum)	Score	Evidence (project documents)
1. Initial ARR activity	Assisted natural regeneration	0	Project description (planting method by stratum)
1. Initial ARR activity	Pit planting	1	Project description (planting method by stratum)
1. Initial ARR activity	Mechanized planting / ploughing / trenching	2	Project description (planting method by stratum)
2. Proportion of non-native species plantings prior to the first verification	0–10%	0	Project description (planting plan and species list); updated with monitoring data
2. Proportion of non-native species plantings prior to the first verification	11–30%	1	Project description (planting plan and species list); updated with monitoring data
2. Proportion of non-native species plantings prior to the first verification	31–60%	2	Project description (planting plan and species list); updated with monitoring data

Indicator	Option (select one per stratum)	Score	Evidence (project documents)
2. Proportion of non-native species plantings prior to the first verification	>60%	3	Project description (planting plan and species list); updated with monitoring data
3. Aboveground biomass (AGB) removals	No harvest	0	Ex-ante projections (validation) or monitoring data (verification)
3. Aboveground biomass (AGB) removals	Tree removal (e.g., fuelwood collection, thinning for forest health) occurs but is <20% of the maximum AGB stored in the project to date.	1	Ex-ante projections (validation) or monitoring data (verification)
3. Aboveground biomass (AGB) removals	AGB removals (projected or actual) are >20% of the maximum AGB carbon stock to date. HR is confirmed and the LTA must be applied.	6	Ex-ante projections (validation) or monitoring data (verification)
4. Project revenues	No timber / woody biomass revenue assessed or reported.	0	Project description (financial analysis / financial additionality)
4. Project revenues	Timber revenue is <5% of expected project revenue.	1	Project description (financial analysis / financial additionality)
4. Project revenues	Timber / woody biomass revenue is >5% of project revenue.	2	Project description (financial analysis / financial additionality)
5. Land restrictions	Land-use designation prohibits harvesting (e.g., conservation easements, protected areas).	0	Land tenure and land-use designation documents
5. Land restrictions	Land-use designation neither prohibits nor allows harvesting.	1	Land tenure and land-use designation documents
5. Land restrictions	Land-use designation requires a minimum harvesting plan (e.g., forest concessions).	2	Land tenure and land-use designation documents
6. Historical harvest behavior of the project proponent	Evidence of zero or residual harvest on the project area and on contiguous lands under the same ownership for a reference period of at least five years.	0	Records of harvest activity over the reference period
6. Historical harvest behaviour of the project proponent	Evidence of harvest activity on the project area and on contiguous lands under the same ownership for a reference period of at least five years.	1	Records of harvest activity over the reference period
7. Ownership type and management objective	Non-industrial private forest (NIPF) owners balancing timber with other services, including NGOs and public entities.	0	Project description (ownership); stakeholder benefit-sharing agreements

Indicator	Option (select one per stratum)	Score	Evidence (project documents)
7. Ownership type and management objective	Private industrial timberland investment organizations.	1	Project description (ownership); stakeholder benefit-sharing agreements

1.3 Total HR score. For each stratum, the total HR score must be calculated as the sum of the seven indicator scores. The maximum possible score is 17.

1.4 Determine whether HR is confirmed. HR is confirmed, and an LTA is required, for any stratum with a total HR score of 6 or more. A score below 6 means HR is not confirmed. Note that selecting the highest-scoring option under indicator 3 (score 6) confirms HR on its own; the remaining indicators do not then need to be scored for that stratum.

Where the HR assessment determines that a stratum is not exposed to HR, the LTA calculation set out in Sections 5.2 to 5.6 does not apply to that stratum. This determination, together with its supporting evidence, must be documented in the project documents and reconfirmed at each verification.

If HR is confirmed for a stratum, apply the LTA calculation (Sections 5.2 to 5.6) to that stratum.

1.5 Document the assessment. For each stratum and each indicator, the project proponent must select the right option, as well as providing the evidence for each score in the project documents, the total score, and the resulting determination. The assessment must be updated at each verification, and whenever there is a change in the forest management plan, planting species, harvest schedule, revenue sources, land-use designation or ownership.

Guidance: The Harvest Risk Assessment tab of the LTA calculation spreadsheet must be used to apply the scoring in Table 2. The project information must be entered, including whether harvest is planned in the project area (if it is, the HR assessment is not required and the LTA Calculator tab must be used directly), each stratum must be named, and one option per indicator must be selected in the yellow cells. The tab returns the total score and shows “LTA APPLIES” or “LTA NOT REQUIRED” for each stratum, and it includes an evidence checklist. The spreadsheet is required; where it differs from this document, this document prevails.

The next sections describe the steps taken after completing the HR Assessment. For each stratum where HR is confirmed:

a. derive the generic parameters $PERR_t$, PC_t and BC_t from the applied methodology (Section 5.2);
b. establish the LTA time period (Section 5.3);
1) quantify the LTA GHG benefit (Section 5.4) and report against it (Section 5.5); and
2) quantify the ILTA carbon stock change used to withhold buffer credits (Section 5.6).

The LTA Calculator and Meth parameters tabs of the LTA calculation spreadsheet support these calculations.

5.2 Standardization of Methodology-specific Parameters

The LTA calculation uses three generic annual parameters: PERRt, which is used to quantify the LTA GHG benefit, and PCt and BCt, which are used to quantify the LTA carbon stock change. Each VCS methodology names and expresses these parameters differently. Table 3 and Table 4 set out the specific parameter and equation for each applicable methodology from which the tool parameter is derived.

Table 3. GHG benefit parameters used in this tool and their equivalents in *VM0047 v1.1*, *VM0045 v1.2*, *VM0003 v1.3*, *VM0005 v1.2*, *VM0034 v2.0*, and *AR-ACM0003 v2.0* (methodology equation numbers given in parentheses)

Tool parameter	Description	*VM0047 v1.1* (area-based)	*VM0047 v1.1* (census-based)	*VM0045 v1.2*	*VM0003 v1.3*	*VM0005 v1.2*	*VM0034 v2.0*	*AR-ACM0003 v2.0*
$PERR_t$	Annual project GHG benefit in year *t* (tCO_2e)	$CR_{annualized}$ (Eq. 32, 34)	$CR_{annualized}$ (Eq. 33, 34)	$ER_t + CR_t$ (Eq. 26, 27)	$(C_{ifm,t2} - C_{ifm,t1}) / T$ (Eq. 46)	ΔC_{IFM} / year number (Eq. 46)	NPE_t / n (Eq. 45, 47)	$\Delta C_{AR\text{-}CDM,t}$ (Eq. 5)

***VM0047 v1.1* (census-based):** $LK_t = 0$.

***VM0005 v1.2*:** annualize ΔC_{IFM} (Eq. 46) by dividing by the number of years until year *t*.

***VM0034 v2.0*:** annualize by dividing by *n*, the number of years in the reporting period.

***VM0003 v1.3*:** annualize the change in carbon stock by dividing $(C_{ifm,t2} - C_{ifm,t1})$ by *T*, the number of years between monitoring times *t1* and *t2* ($T = t2 - t1$).

Table 4. Carbon stock parameters used in this tool and their equivalents in *VM0047, v1.1*, *VM0045, v1.2*, *VM0003, v1.3*, *VM0005, v1.2*, *VM0034, v2.0*, and *AR-ACM0003, v2.0* (methodology equation numbers given in parentheses)

Tool parameter	Description	*VM0047 v1.1* (area-based)	*VM0047 v1.1* (census-based)	*VM0045 v1.2*	*VM0003 v1.3*	*VM0005 v1.2*	*VM0034 v2.0*	*AR-ACM0003 v2.0*
PC_t	Annual project carbon-stock change in year *t* (tCO_2e)	$C_{WP,t}$ / *x* (Eq. 1, 34)	$C_{WP,t}$ / *x* (Eq. 22, 34)	1/n × Σ ($\Delta CO_{2wp,i,t}$) (Eq. 33)	ΔC_p (Eq. 11)	(ΔC_{WPS} − $GHG_{WPS-E,t}$) / year number (Eq. 33)	$\Delta T_{RPP,t}$ / *n* (Eq. 35, 37)	$\Delta C_{P,t}$ (Eq. 3)
BC_t	Annual baseline carbon-stock change in year *t* (tCO_2e)	0*	0	1/n × Σ ($\Delta CO_{2bsl,i,t}$) (Eq. 33)	$\Delta C_{bsl,p}$ (Eq. 2)	(ΔC_{BSL} − $GHG_{BSL-E,t}$) / year number (Eq. 2)	$\Delta T_{RBP,t}$ / *n* (Eq. 32, 37)	$\Delta C_{BSL,t}$ (Eq. 1)

* Where the table indicates "0", the baseline carbon stock is already embedded in the applied methodology's performance benchmark, and no separate baseline stock-change value is entered; BC_t must be set to 0 for each year *t*.

VM0045, v1.2*:** $\Delta CO_{2wp,i,t}$ (for PC_t) and $\Delta CO_{2bsl,i,t}$ (for BC_t) are the cumulative carbon stock change in the project and baseline scenarios, respectively, at sample unit *i* **through year *t (tCO_2e per unit area). Summation is over the sample units i = 1 to i = n (Eq. 33). Here, *n* is the number of sample units.

***VM0047, v1.1*:** annualize $C_{WP,t}$ by dividing by *x*, the number of years in the monitoring period. The baseline carbon stock change is absorbed into the performance benchmark (PB_t) for the area-based approach, and there is no baseline stock change for the census-based approach; BC_t = 0 in both cases.

***VM0005, v1.2*:** annualize (ΔC_{WPS} − $GHG_{WPS-E,t}$) for PC_t and (ΔC_{BSL} − $GHG_{BSL-E,t}$) for BC_t by dividing by the number of years until year *t*.

***VM0034, v2.0*:** annualize the stock change over the reporting period by dividing by *n*, the number of years in the reporting period ($\Delta T_{RPP,t}$ for PC_t and $\Delta T_{RBP,t}$ for BC_t).

***AR-ACM0003, v2.0*:** $GHG_{nonCO2,t}$ (CH4 and N2O from burning) is deducted in BE_t, not in PC_t. BC_t = BE_t: the same $\Delta C_{BSL,t}$ feeds both the net GHG benefit and the carbon stock calculation, since there are no fossil-fuel flux components.

Guidance: The Meth parameters tab of the LTA calculation spreadsheet must be used to derive the generic parameters $PERR_t$, PC_t and BC_t. For each applicable methodology, the tab sets out the specific parameter, equation and carbon pools (as in Table 3 and Table 4) and gives instructions on how to find and annualize the needed values. The derived values for each year *t* must then be entered in PART C of the LTA Calculator tab ($PERR_t$ in column D, PC_t in column H and BC_t in column I).

5.3 LTA Time Period

Forest management plans are required for all projects including tree harvesting.[3] Where the LTA calculation is applied, project proponents must provide harvesting schedules, including but not limited to expected duration of the full harvesting cycle of the longest cycle in the project, timing of replanting, and species composition. If the forest management plan changes after validation, this must be documented at the subsequent verification, and the LTA Tool must be reapplied using updated information.

The LTA must be calculated across a time period of no less than 40 years (the minimum project longevity).

The time period (*n*) of which the LTA is calculated must be the longer of:

1) 40 years, equal to the minimum project longevity

2) The whole duration (in years) of complete harvesting cycles that is at least as long as the project crediting period.

The harvesting cycle must be as long as or longer than the project crediting period, so the project crediting period must fully encapsulate at least one complete harvesting cycle of the longest cycle included in the project. For example, where the total project crediting period is 40 years and has a harvest cycle of 12 years, the LTA GHG benefit will be determined for a period of 48 years. Where the crediting period is 20 years, the LTA must be calculated as a minimum of 40 years or the whole duration of the complete harvesting cycle.

Guidance: in PART A of the LTA Calculator tab of the LTA calculation spreadsheet, the project name, stratum name, management regime, crediting period start date and length, and (for even-aged management with harvesting) the rotation / cutting cycle length must be entered. The spreadsheet then calculates the number of years in the LTA period (*n*), shown in PART A and PART D.

5.4 LTA GHG Benefit Quantification

Where an LTA Calculation is required, the project description and forest management plans must include detailed plans for replanting after harvest.

Replanting is required after every harvest, including any harvest that occurs after the crediting period has ended.

Figure 1 illustrates an area-based *VM0047* afforestation project subject to periodic partial harvesting: the cumulative project GHG benefit (blue) grows during each rotation and falls back

[3] *VCS standard v5*: "Proponents of projects with tree harvesting shall: […]
3. include post-harvest replanting and subsequent harvest plans in a government- or professional forester-approved forest management plan."

at each of the four harvests happening over 50 years, while the LTA GHG benefit (purple) is calculated at the 40-year crediting period limit. The dashed red line represents the LTA as a function of time.

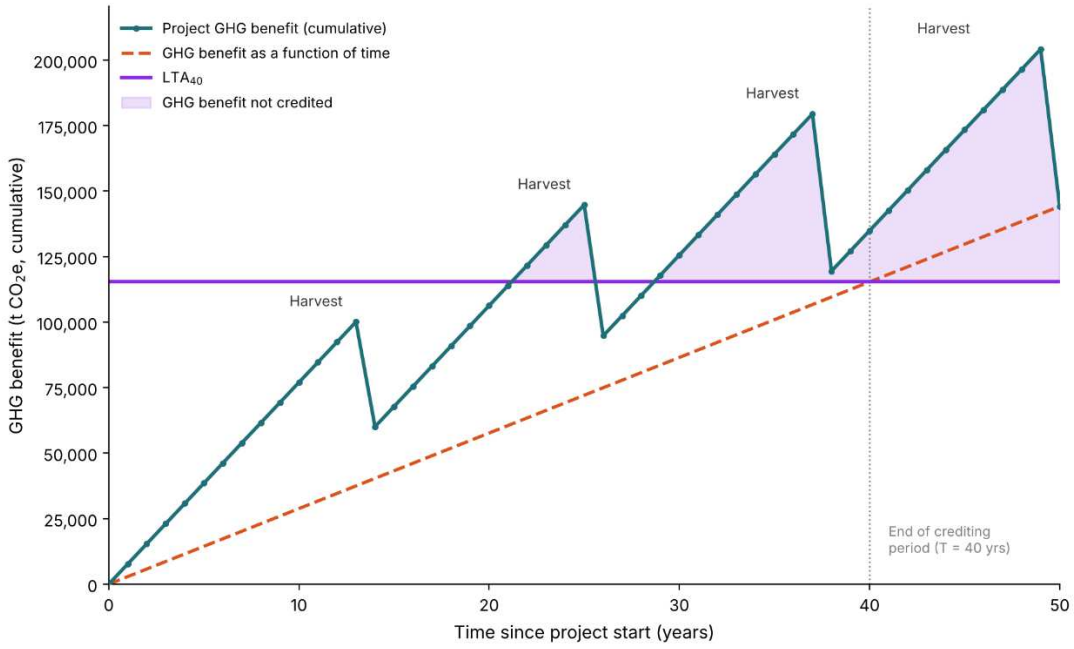


Figure 1. Project GHG benefit and LTA GHG benefit over time for a *VM0047* project with three harvest cycles over 50 years.

The LTA GHG benefit must be quantified for each stratum where HR is confirmed (or for the project area, where the project is not stratified), and this calculation must be completed in the LTA calculation spreadsheet.

The following equation must be applied to estimate the GHG benefit:

$$LTA_{CP} = \frac{\text{MAX}(CP, 40)}{n} \times \sum_{t=0}^{t=n} PERR_t \quad (1)$$

Where:

LTA_{CP}	=	LTA GHG benefit at the end of the crediting period (tCO_2e)
CP	=	Length of the crediting period (years)
n	=	Number of years in the LTA period (years)
$PERR_t$	=	Net project GHG benefit in year t (tCO_2e)

Guidance: in the LTA Calculator tab of the LTA calculation spreadsheet, $PERR_t$ must be entered in PART C for each year of the LTA period (column D: monitored values for elapsed years and ex-ante projections for future years). Equation 1 is then calculated in PART D, which also shows n and the sum of $PERR_t$.

Notes:

- Baseline GHG benefits are included in the term $PERR_t$, as specified in Table 1; therefore, comparison of $PERR_t$ to baseline is not necessary.
- At validation, $PERR_t$ values are estimated (ex-ante) for the whole duration of the crediting period; at verification (year t), $PERR_t$ uses monitored values up to year t and estimates from year t onwards.
- If the crediting period is shorter than 40 years, the LTA is quantified on a 40-year basis.

5.5 Reporting Against the LTA GHG Benefit

A project may seek GHG credits during each verification event until the LTA GHG benefit is reached. Once the total number of verified GHG benefits has reached this average, the project proponents can no longer report and verify GHG benefits, as illustrated in Figure 2Figure 2. The LTA GHG benefit must be calculated at each verification event, meaning the LTA GHG benefit may change over time based on monitored data.

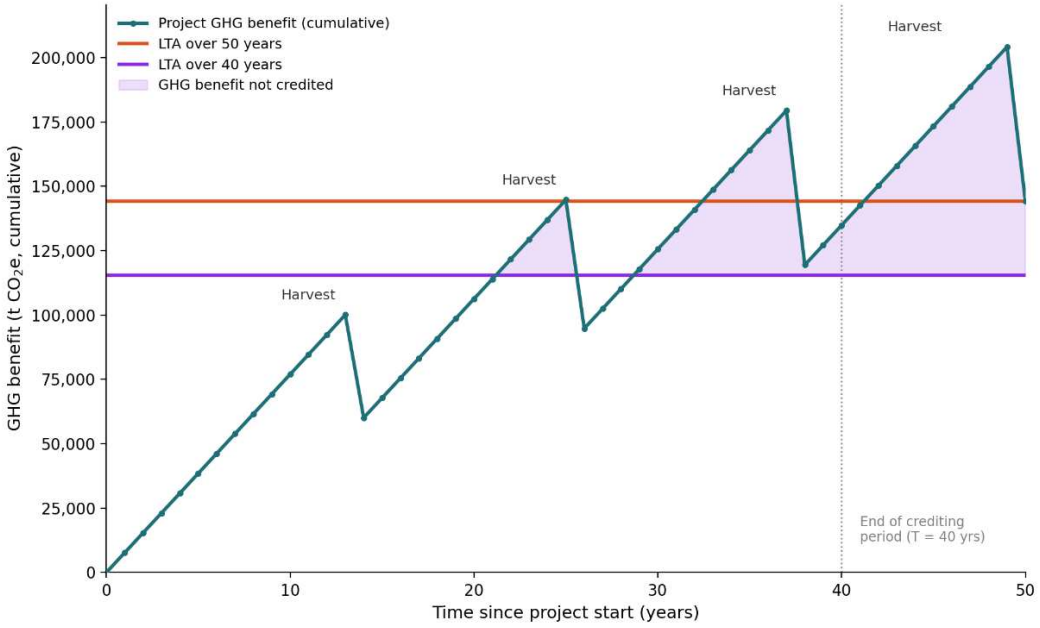


Figure 2. Cumulative GHG benefit exceeding the LTA

At each verification event, projects must:

1. Requantify LTA_{CP} using Equation (1) and monitored $PERR_t$ values.
2. Quantify the cumulative project GHG benefit from project start date up to year t.

$$PERR_{cm,t} = \sum_{t=0}^{t} PERR_t \quad (2)$$

Where:

$PERR_{cm,t}$ = cumulative project GHG benefit from project start date up to year t (tCO_2e)

3. Report GHG benefit for the current monitoring period only up to the maximum project GHG benefit before LTA_{CP} is reached.

$$PERR_{max,t} = MAX(0, \text{LTA}_{CP} - PERR_{cm,t-1}) \quad (3)$$

Where:

$PERR_{max,t}$ = maximum project GHG benefit that may be reported in year t (tCO_2e)

$PERR_{cm,t-1}$ = The sum of all GHG benefit verified prior to year t (tCO_2e)

4. If $PERR_{cm,t-1} = LTA_{CP}$, no further GHG benefits may be reported and verified in subsequent verifications.

Guidance: in the LTA Calculator tab of the LTA calculation spreadsheet, the cumulative project GHG benefit $PERR_{cm,t}$ (Equation 2) is calculated in PART C (column E). In PART E, the sum of all GHG benefits verified prior to year t ($PERR_{cm,t-1}$) must be entered; the spreadsheet then shows LTA_{CP} and calculates $PERR_{max,t}$ (Equation 3), together with a check showing whether LTA_{CP} has been reached. The calculation must be run separately for each stratum and repeated at each verification event, with the monitored values updated.

5.6 Reporting Buffer Credits

Buffer credits are withheld only when GHG credits are issued. The number of buffer credits to withhold is based on the change in carbon stocks only (not the net GHG benefit); as such, the buffer credits will be based on the LTA change in carbon stock. Use the following equation to calculate the LTA change in carbon stock at each verification event:

$$LTC_{CP} = \frac{MAX(CP, 40)}{n} \times \sum_{t=0}^{t=n} PC_t - BC_t \quad (4)$$

Where:

LTC_{CP} = Long-term average carbon stock change at the end of the crediting period (tCO_2e)

CP	=	Length of the crediting period (years)
n	=	Number of years in the LTA period (years)
PC_t	=	Total to-date carbon stock in the project scenario (tCO_2e)
BC_t	=	Total to-date carbon stock projected for the baseline scenario (tCO_2e)

Guidance: in the LTA Calculator tab of the LTA calculation spreadsheet, PC_t and BC_t must be entered in PART C (columns H and I; column J calculates $PC_t - BC_t$ for each year). PART D then calculates the sum of $PC_t - BC_t$ and LTC_{CP} (Equation 4).

Then, project VCUs are quantified by subtracting buffer credits from the project GHG benefits, see Figure 3 below.

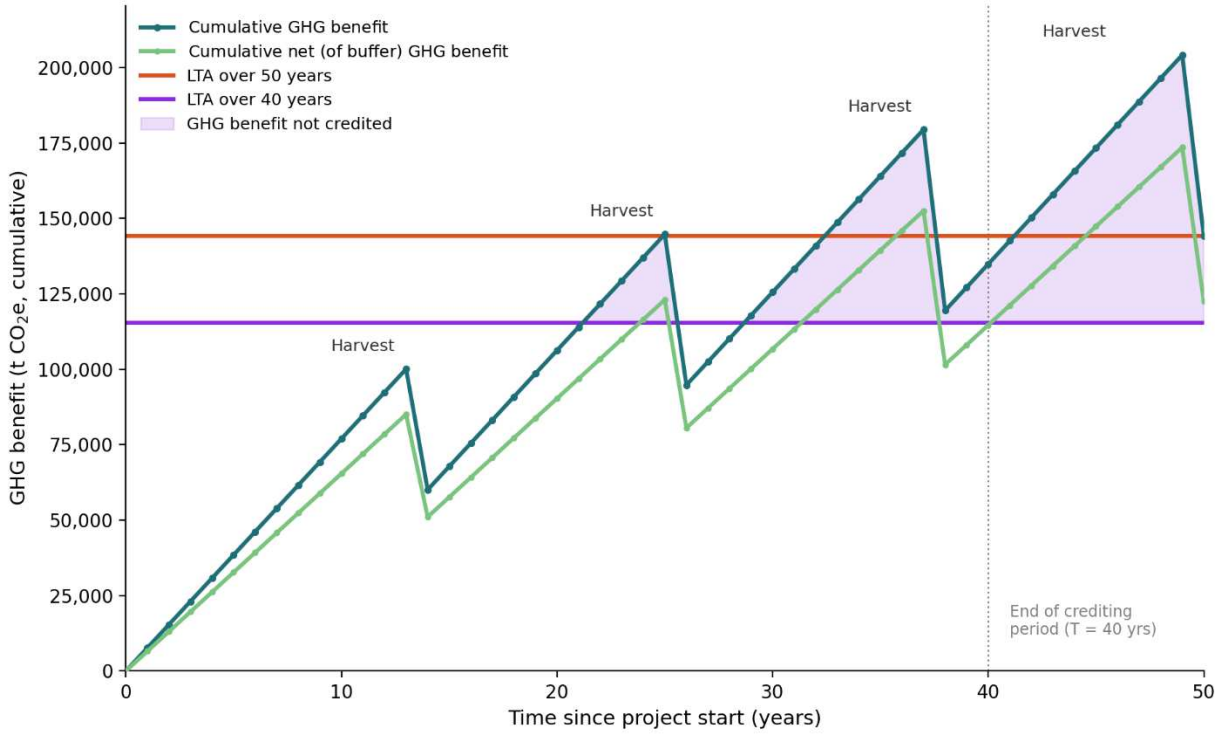


Figure 3. Cumulative net GHG benefit over time

At each verification event, project proponents must:

1. Requantify LTC_{CP} using Equation (4) and monitored PC_t and BC_t values.
2. Report carbon stocks for the current monitoring period only up to the maximum carbon stock change LTC_{CP} is reached.

$$LTC_{max,t} = MAX(0, \text{LTC}_{CP} - LTC_{t-1}) \quad (5)$$

Where:

$LTC_{max,t}$ = maximum carbon stock change that may be reported in year *t* (tCO_2e)
LTC_{t-1} = Carbon stock change verified prior to year *t* (tCO_2e)

3. If $LTC_{t-1} = LTC_{CP}$, no further carbon stock change may be reported and verified in subsequent verifications.

5.7 Data and Parameters Available at Validation

There are no changes to the data and parameters in *VM0003, VM0005, VM0012, VM0034, VM0045, VM0047, AR-ACM0003, AR-ASM0007, M0274.* Table 3 and Table 4 in Section 5 describe equivalence between parameter names used in the original methodologies and those used in this tool.5

The three generic parameters used in the LTA calculation (Sections 5.4 to 5.6) are described below. The equations used to derive each parameter from the applied methodology are given in Table 3 and Table 4 (Section 5.2) and in the Meth parameters tab of the LTA calculation spreadsheet.

Data/Parameter	$PERR_t$
Data unit	tCO_2e
Description	Net project GHG benefit in year *t* of the LTA time period. Generic annual input used to quantify the GHG benefit.
Equations	(1), (2)
Source of data	Derived from the equations of the applied methodology: *VM0047 v1.1* (area-based): $CR_{annualized}$ (Eq. 32, 34) *VM0047 v1.1* (census-based): $CR_{annualized}$ (Eq. 33, 34) *VM0045 v1.2*: $ER_t + CR_t$ (Eq. 26, 27) *VM0003 v1.3*: $(C_{ifm,t2} - C_{ifm,t1}) / T$ (Eq. 46) *VM0005 v1.2*: ΔC_{IFM} / year number (Eq. 46) *VM0034 v2.0*: NPE_t / n (Eq. 45, 47) *AR-ACM0003 v2.0*: $\Delta C_{AR\text{-}CDM,t}$ (Eq. 5)
Value applied	Project-specific. One value for each year *t* of the LTA time period.

Justification of choice of data or description of measurement methods and procedures applied	At validation, $PERR_t$ is estimated (ex-ante) for the whole LTA time period. At verification, monitored values are used up to year *t* and estimates are used from year *t* onwards. Where the methodology expresses the quantity over a period rather than per year, annualize it: for *VM0005 v1.2*, divide ΔC_{IFM} by the number of years until year *t*; for *VM0034*, divide NPE_t by *n*, the number of years in the reporting period. For *VM0047* (census-based), $LK_t = 0$. For *VM0003 v1.3*, annualize by dividing the change in carbon stock between monitoring times *t1* and *t2* by *T*, the number of years between *t1* and *t2* ($T = t2 - t1$).
Purpose of data	Calculation of the LTA GHG benefit (LTA_{CP}) and of the maximum GHG benefit that may be reported at each verification event.
Comments	Baseline GHG benefit is included in $PERR_t$, so no separate comparison with the baseline is needed. Apply for each stratum where HR is confirmed. In the LTA calculation spreadsheet, the values must be derived in the Meth parameters tab and entered in the LTA Calculator tab (PART C).

Data/Parameter	PC_t
Data unit	tCO_2e
Description	Total to-date carbon stock in the project scenario in year t. Generic annual input used, with BC_t, to quantify the LTA carbon stock change.
Equations	(4)
Source of data	Derived from the equations of the applied methodology *VM0047 v1.1* (area-based): $C_{WP,t} / x$ (Eq. 1, 34) *VM0047 v1.1* (census-based): $C_{WP,t} / x$ (Eq. 22, 34) *VM0045 v1.2*: $1/n \times \Sigma \Delta CO_{2wp,i,t}$ (Eq. 33) *VM0003 v1.3*: ΔC_p (Eq. 11) *VM0005 v1.2*: ($\Delta C_{WPS} - GHG_{WPS-E,t}$) / year number (Eq. 33) *VM0034 v2.0*: $\Delta T_{RPP,t} / n$ (Eq. 35, 37) *AR-ACM0003 v2.0*: $\Delta C_{P,t}$ (Eq. 3)
Value applied	Project-specific. One value for each year *t* of the LTA time period.

Justification of choice of data or description of measurement methods and procedures applied	Use the pools and equations of the applied methodology. For *VM0047*, divide $C_{WP,t}$ by x, the number of years in the monitoring period. For *VM0005 v1.2*, divide by the number of years until year *t*. For *VM0034*, divide the stock change by *n*, the number of years in the reporting period. At validation, PC_t is estimated (ex-ante); at verification, monitored values are used up to year *t* and estimates from year *t* onwards. For *VM0045 v1.2*, $\Delta CO_{2wp,i,t}$ is the cumulative carbon stock change in the project scenario at sample unit *i* through year *t* (tCO_2e per unit area) and *n* is the number of sample units.
Purpose of data	Calculation of the long-term average carbon stock change (LTC_{CP}), which determines the buffer credits to be withheld.
Comments	For *AR-ACM0003*, $GHG_{nonCO2,t}$ (CH_4 and N_2O from burning) is deducted in BE_t, not in PC_t. In the LTA calculation spreadsheet, the values must be derived in the Meth parameters tab and entered in the LTA Calculator tab (PART C).

Data/Parameter	BC_t
Data unit	tCO_2e
Description	Total to-date carbon stock projected for the baseline scenario in year t. Generic annual input used, with PC_t, to quantify the LTA carbon stock change.
Equations	(4)
Source of data	Derived from the equations of the applied methodology *VM0047 v1.1* (area-based and census-based): 0 *VM0045 v1.2*: $1/n \times \Sigma\ \Delta CO_{2bsl,i,t}$ (Eq. 33) *VM0003 v1.3*: $\Delta C_{bsl,p}$ (Eq. 2) *VM0005 v1.2*: $(\Delta C_{BSL} - GHG_{BSL\text{-}E,t})$ / year number (Eq. 2) *VM0034 v2.0*: $\Delta T_{RBP,t} / n$ (Eq. 32, 37) *AR-ACM0003 v2.0*: $\Delta C_{BSL,t}$ (Eq. 1)
Value applied	Project-specific. One value for each year *t* of the LTA time period; 0 for *VM0047*.

Justification of choice of data or description of measurement methods and procedures applied	For *VM0047*, the baseline carbon stock change is embedded in the performance benchmark (PB_t), so no separate baseline stock change is entered and $BC_t = 0$. For *VM0005 v1.2*, annualize by dividing by the number of years until year *t*. For *VM0034*, annualize by dividing by n, the number of years in the reporting period. For *VM0045 v1.2*, $\Delta CO_{2bsl,i,t}$ is the cumulative carbon stock change in the baseline scenario at sample unit *i* through year *t* (tCO_2e per unit area) and *n* is the number of sample units.
Purpose of data	Calculation of the long-term average carbon stock change (LTC_{CP}), which determines the buffer credits to be withheld.
Comments	For *AR-ACM0003*, $BC_t = BE_t$: the same $\Delta C_{BSL,t}$ feeds both the net GHG benefit and the carbon stock calculation, because there are no fossil-fuel flux components. In the LTA calculation spreadsheet, the values must be derived in the Meth parameters tab and entered in the LTA Calculator tab (PART C).

5.8 Data and Parameters Monitored

There are no changes to the data and parameters in *VM0003, VM0005, VM0012, VM0034, VM0045, VM0047, AR-ACM0003, AR-ASM0007, M0274.* Table 3 and Table 4 in Section 5 describe equivalence between parameter names used in the original methodologies and those used in this tool.5

DOCUMENT HISTORY

Version	Date	Comment
v1.0	18 November 2027	Initial version