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ANNEX 1

A6.4-PMM012, Verra's VM0047 and Isometric Reforestation: comparison tables

This annex compares A6.4-PMM012 v1.6 (proposed Article 6.4 A/R methodology, resubmitted 3 October 2026); Verra's VM0047 v1.1 (14 May 2025); and Isometric Reforestation Protocol v1.1 (the ICVCM-approved version; see footnote 1 for more information). Section, paragraph and equation numbers refer to each source document.

Baseline, additionality and quantification

	A6.4-PMM012 v1.6	VM0047 v1.1 (area-based)	Isometric Reforestation v1.1[1]
Baseline type	Existing actual or historical stocks, downward adjusted; explicitly rejects benchmark approaches citing limited sectoral data (paras 55–56)	Dynamic performance benchmark: ratio of control-plot to project-plot change in stocking index (Eq. A8)	Dynamic baseline: the counterfactual is CO_2 stored through natural regeneration on matched control pixels; performance benchmark = stored ÷ counterfactual (Eq. 19), with the counterfactual set to zero if controls decline (Eq. 18)
Update	Fixed for the first 15-year crediting period, reset at renewal	Each verification or every five years, whichever comes first (A1.1)	Controls reviewed at each verification; control pixels that decline are reviewed and replaced if the decline continues (9.4.4). Reporting periods of 1–5 years
Counterfactual evidence	All AR activities within 30 km over the past 3 years, excluding contextually different zones, minimum 3 comparison areas	k-nearest-neighbour Mahalanobis matching; at least 30 project plots; donor pool within 100 km, widened in 100 km steps if matching fails; exclusions for ecoregion, policy environment and tenure; standardised mean difference ≤0.25 per covariate; stocking index at three time windows from t−10 to t0	Remote-sensing forest carbon proxy; each project pixel matched to at least 10 control pixels using at least five historical time points; donor zone within 100 km, widened in 10 km steps; time-for-space substitution up to 15 years where needed (9.4.1–9.4.3)

	A6.4-PMM012 v1.6	VM0047 v1.1 (area-based)	Isometric Reforestation v1.1[1]
Additionality	Regulatory surplus, lock-in avoidance, investment analysis by default (simple cost where non-carbon revenue <5%, else benchmark or investment comparison), restricted barrier analysis, common practice	Regulatory surplus, performance benchmark Z test ($\|Z\| \geq 1.96$) repeated at each verification, investment analysis unless there is no non-carbon revenue	Regulatory surplus (subsidies or contractual obligations inhibit additionality); common practice at or below 20% penetration; project change must be statistically greater than controls ($p < 0.05$); reviewed each verification, with non-additional projects losing future credits (7.4, 9.4.4)
Leakage	Activity shifting via AR-TOOL15; market leakage zero	VMD0054 for activity shifting and market leakage	Market leakage plus an activity-shifting adjustment plus leakage mitigation emissions (Eq. 1), counted as a project emission in net removals (Eqs. 12, 20); ecological leakage assumed zero
Uncertainty	AR-TOOL14 precision thresholds, deductions where not met	90% CI half-width minus 10%; zero credits if half-width exceeds 100% of removals; 10% minimum ex ante	Net removals must be conservatively determined, with minimum and maximum values and a sensitivity analysis for key variables (7.5). Baseline uncertainty is applied to the counterfactual, covering proxy-map error, proxy representativeness, variation across matched controls and control suitability (9.4.5); additionality requires $p < 0.05$ inclusive of uncertainty (9.4.4). No fixed percentage deduction
Pools	AGB, BGB, dead wood (inconsistent); SOC and litter excluded	AGB, BGB; SOC required with repeated disturbance, harvest or inversion below 25 cm	Living above- and belowground woody biomass; SOC excluded
Nitrogen	Synthetic N fertiliser prohibited (applicability)	N_2O from fertiliser accounted as a project emission	Synthetic fertilisers and herbicides should not be used (6.7); direct N_2O from any nitrogen fertiliser accounted (Table 1)
Monitoring	At least every 5 years; field plots or integrated dMRV	Woody biomass at least every 5 years	Third-party verification each reporting period (1–5 years); site visits at validation and first verification
Crediting period	15 years, renewable twice, 45 years maximum	Minimum 40 year project longevity (30 year minimum crediting period)	From project initiation to the end of the last reporting period; ends if verification is not started within 5 years of the previous period (5.2–5.3)

Leakage

	A6.4-PMM012 v1.6	VM0047 v1.1 via VMD0054	Isometric Reforestation v1.1
Tool	CDM AR-TOOL15, "latest approved version" (para 6); LK_t = LK_DISP,t (para 76)	VMD0054 v1.0 (Sept 2023), itself informed by AR-TOOL15 v2.0. v1.1 active since 13 January 2026	Built into the protocol (section 8.3, Eq. 1)
Leakage types counted	Activity shifting only. Market leakage (competition for resource use) set to zero as immaterial and not attributable with reasonable certainty (para 72)	Activity shifting by the baseline agent and market leakage by other actors	Market leakage and activity shifting; ecological leakage assumed zero
Displaced activities	Agriculture, grazing, harvesting; fuelwood not named (para 72)	Agriculture including grazing, plus fuelwood collection	Commercial commodities (market leakage, possibly activity shifting) and subsistence use (activity shifting); subsistence use that is not fully mitigated makes the project ineligible
Quantification	Uses AR-TOOL15 v2.0 (CDM, 2013): Leakage = carbon lost on the land that receives displaced crops or grazing (Eqs. 1–3). Displaced area × [tree biomass × 1.1 for dead wood and litter, with root-shoot 0.25, plus shrubs at 0.40] × carbon fraction 0.47, plus SOC change from IPCC land-use factors. If the receiving land is unknown, IPCC regional forest biomass is assumed. Grazing displacement is zero within carrying capacity, onto recently abandoned cropland, into forest without clearing, or to zero-grazing; crop displacement has no such exemptions. Market effects are set to zero (Note 2).	Foregone production against a historical reference (greater of 3 years or one crop rotation), grown at a default 2.5% yield growth per year. Defaults: 75% of foregone agricultural output replaced elsewhere, 40% of that from new land; 100% for fuelwood. New land assumed to be forest with total biomass loss, plus 20-year SOC change	Pre-project productivity averaged over 3 years from a data hierarchy (farm records, land registry, remote sensing); market leakage uses IS and NL factors and an IPCC forest carbon stock factor (8.3.5)
Mitigation	Ex-ante avoidance by design: lower-displacement-risk land categories, maintaining pre-project livelihood functions, no machinery relocation, local and temporary inputs (para 74)	Optional leakage mitigation areas in the same production region, not overlapping other projects, with a landowner agreement of at least 5 years; verified production gains there offset foregone production	Leakage mitigation allowed, with its own emissions counted in Eq. 1

	A6.4-PMM012 v1.6	VM0047 v1.1 via VMD0054	Isometric Reforestation v1.1
Assessment period	Must cover "both permanent and temporary cases"; no period stated	5 years from project start (or last instance start for grouped projects)	Leakage quantified for the first reporting period (Eq. 1). Where only market leakage is mitigated, a Leakage Monitoring Zone (the smaller of a 5 km buffer or five times the project area) is checked by satellite at every verification, with follow-up if its deforestation rate exceeds the regional average (8.3.6)
Thresholds and defaults	No insignificance threshold stated	No numeric de minimis threshold; less conservative defaults need peer-reviewed, commodity- and region-specific evidence	Default IS and NL values required in Brazil, Panama, Mexico and the US unless Isometric approves alternatives (13.1). NL: Brazil cropland 0.61, livestock 0.83; US cropland 0.28, livestock 0.20; Mexico and Panama use Brazil values; global coffee 0.60. IS from supply and demand elasticities, e.g. global staple calories 0.70, South American livestock 0.5 (Tables A1–A2)
Positive and trans-boundary leakage	Positive leakage only with an approved A6.4 tool; affected Party's DNA informed of trans-boundary leakage	v1.1 adds accounting for new commodities produced in the project area, and lets low-forest regions use the most common native ecosystem as the conversion reference	Positive or secondary effects not credited: v1.1 says they "are not considered in this Protocol" (8.1.1.3); v1.2 asks projects to quantify secondary emissions and assess materiality. No geographic limit on leakage; market leakage is modelled
Census / no land-use change	Not applicable	Leakage set to zero because pre-project land use is maintained and planting density is capped	Not applicable

Permanence

	A6.4-PMM012	VM0047 v1.1 via VCS programme rules	Isometric Reforestation v1.1
Where the rules sit	In the methodology (section 13), drawing on the A6.4 Reversals Standard (A6.4-SBM023-A14) and the draft Reversal Risk Assessment Tool (A6.4-MEP016-A07)	Not in the methodology; set by the VCS Standard v5.0 and the AFOLU Non-Permanence Risk Tool	In the protocol (section 10) and the Isometric Standard

	A6.4-PMM012	VM0047 v1.1 via VCS programme rules	Isometric Reforestation v1.1
Risk assessment	Draft A6.4 reversal risk tool; a DOE reviews, revises and verifies it every 5 years from the start of the first crediting period	AFOLU Non-Permanence Risk Tool scoring internal, external and natural risks into a project risk rating; risk report at validation and each verification (VCS 3.2.11)	Reforestation Risk Assessment (Appendix E), updated each reporting period; higher scores trigger additional mitigation (10.3). Eligibility requires a total score of 20 or less, with category caps: proponent capacity 7, financial viability 8, social governance 11, disturbance 12 (Table E1)
Buffer equation	PMM012 Eq. 5: A6.4ER_buffer,t = C_NET,t × Risk_fraction,t, i.e. on net removals after baseline and leakage. The Reversals Standard Eq. 8 instead sizes it on the positive net storage change per reservoir: Σ max(0, ΔS_i,t) × F_buffer,i,t (para 31). Alternatives are allowed only if aligned or justified as conservative (para 32). SOP, OMGE and buffer are all deducted from the total at issuance (PMM012 Eq. 7)	No buffer equation in VM0047. VCS Standard v5.0 §3.14.15: buffer credits = non-permanence risk rating × change in carbon stocks only (not leakage or non-CO_2 sources), deducted alongside leakage to give VCUs issued	Either a flat 20% of credits generated in each reporting period, or a risk-based contribution that cannot fall below 10% (10.4.1). Risk-based: each category score is mapped through a logistic curve, BP = 7.5 / (1 + e^(−k(x − x_o))) + 2.5, and the category contributions are summed (Appendix G, Eq. G1)
Is the buffer booked?	Not yet. Contributions are "considered as 'forwarded'" without a first transfer, pending a Supervisory Body decision (Reversals Standard, footnotes 3 and 25). The Reversal Risk Buffer Pool Account is defined as a registry account administered by the secretariat	Yes. Credits are deposited in the AFOLU pooled buffer account, cannot be traded, and are governed by an AFOLU Buffer Deed (3.2.16, 3.2.27). Buffer credits may be released based on the risk analysis (3.2.17)	Yes. Credits are contributed to the Isometric buffer pool each reporting period
Reversal quantification	PMM012 Eq. 6: REV_t = C_ACT,t−1 − C_ACT,t whenever activity stocks decline. The Reversals Standard measures crediting-period reversals against the baseline (ΔS_t < 0 for t ≥ 2, Eq. 1), so stalled growth against a rising baseline also counts. Post-crediting reversals compare activity stocks with the stock at the end of crediting (Eq. 2)	Loss quantified with the applied methodology (for VM0047, stock difference) or an approved remote-sensing approach; where that is not possible, loss of all previously verified removals is assumed. The loss is restated at the next verification (3.2.19, 3.2.22)	Losses above 1% of cumulative removals must be reported, investigated and compensated; quantified from the relative change in an aboveground biomass proxy, assuming all carbon in lost live woody biomass is released; field sampling required for reversals around 20% of cumulative removals (10.5)

	A6.4-PMM012	VM0047 v1.1 via VCS programme rules	Isometric Reforestation v1.1
Credit cancellation	A6.4ERs cancelled from the buffer pool account to remediate reversals, matching authorisation status (AERs or MCUs). Reversals are classed avoidable or unavoidable, with unidentified causes "avoidable by default" (paras 43–46), but the standard sets no duty to replenish the buffer and no deadline. Because contributions are only forwarded, the cancellation mechanics are still unresolved	Buffer credits cancelled to cover carbon lost (2.4). Avoidable reversal: no further VCUs to the project, or to the proponent's other projects, until the full reversal is remedied (3.2.23(2)). Unavoidable: baseline may be reassessed, and regrowth is not credited until the loss is recovered. Durability pilot projects remedy reversals with replacement VCUs, and reversed VCUs are flagged on the registry	Post-crediting reversals fully compensated from the buffer within one year of the loss event (10.4.3). Project failure or abandonment cancels all credits issued; loss of land tenure can cancel credits (5.1, 4.4)
Other deductions at issuance	5% Share of Proceeds and 2% OMGE (Eq. 7)	None at methodology level	None at protocol level
Length of obligation	Up to 45 years of crediting plus 100 years of post-crediting monitoring: up to 145 years	Project longevity of at least 40 years, with permanence monitored for at least 40 years (3.2.12, 3.2.25). Verra is also considering a Long-Term Monitoring System to address any reversals post-project crediting period.	Crediting period plus an Ongoing Monitoring Period of 40 to 100 years (5.4)
Monitoring after crediting	Activity participants report at most every 5 years for 100 years after the last crediting period, verified by a DOE	Project level: remote sensing allowed for the rest of the longevity period where crediting ends first (3.2.19(2)(c)). Programme level: Verra's Long-Term Monitoring System, run by Verra rather than the proponent, uses remote sensing to detect post-crediting losses across VCS AFOLU projects; the durability pilot uses it to detect losses (pilot §1.9)	Isometric itself monitors for reversals throughout the Ongoing Monitoring Period (5.4)
Exit conditions	Cancel A6.4ERs equal to all issued; or insurance or guarantee approved by the Supervisory Body; or a negligible-risk finding (stable stocks at the 95% lower confidence bound, legal land-use security, reversal risk ≤2.5% as a placeholder, steady state for 100 years). As argued in Who's Afraid of the Big, Bad Forest?, an AR project will never meet negligible risk: a living forest cannot demonstrate a 100-year steady state. In practice the exits are full payback or approved insurance	Obligations end with the longevity period; no steady-state test	Obligations end with the Commitment Period; a long-term durability plan is required beyond it (5.5); no steady-state test

	A6.4-PMM012	VM0047 v1.1 via VCS programme rules	Isometric Reforestation v1.1
Alternatives to the buffer	Insurance or guarantee, but only as an exit route and subject to Supervisory Body approval	Durability pilot launched with VCS v5.0 in December 2025 for 3 years: insurance or a fund-based approach in place of the pooled buffer for projects that pass the risk assessment	Risk-based buffer contributions reward lower-risk sites and mitigation measures, with a 10% floor (10.4.1)
Evidence base acknowledged	Para 98 concedes the data is geographically skewed, relies on natural rather than planted regrowth, has no tropical planted-forest meta-analysis, and treats 100 years as a policy convention	Not addressed in the methodology	Not addressed in the sections reviewed

Safeguards

	A6.4-PMM012 v1.6 via Article 6.4 rules	VM0047 v1.1 via VCS programme rules	Isometric Reforestation v1.1
Where the rules sit	No safeguards section in the methodology, by design. The A6.4 SD Tool is mandatory for all proposed A6.4 activities (SD Tool para 9), alongside mandatory local and global stakeholder consultation and the mechanism's Appeal and Grievance Procedure	No safeguards section in the methodology; set by the VCS Standard v5.0, sections 3.17 (stakeholder engagement) and 3.18 (safeguards)	In the protocol (sections 4 and 6) and the Isometric Standard
Framework	A6.4 SD Tool v1.0, adopted at SBM014 (October 2024): 11 safeguard elements applied through a risk assessment form, an environmental and social management plan and a sustainable development impact form. Draft v2.0 (A6.4-SBM021-AA-A03) is still under consideration; it would apply REDD+ requirements, including consistency with the seven Cancun safeguards, to A/R, agroforestry and IFM removals	ESG risk assessment on Verra's template before project start (3.18.1), plus ESG Risk Monitoring Report and Stakeholder Engagement Plan templates. Most v5.0 updates mandatory from 1 July 2027	Protocol-level environmental and social requirements, including a High Conservation Value assessment and adaptive management

	A6.4-PMM012 v1.6 via Article 6.4 rules	VM0047 v1.1 via VCS programme rules	Isometric Reforestation v1.1
FPIC and rights	SD Tool Element 9: no relocation of Indigenous Peoples without FPIC (E9.3); FPIC required where there are impacts on Indigenous territory, land or resources, or on cultural heritage (E9.5); collective land rights respected (E9.4). Rights recognised under host Party law (para 82). Element 8: avoid involuntary resettlement and restore livelihoods where displacement is unavoidable (E8.1–E8.2)	FPIC from customary rights holders and Indigenous Peoples before project start where they are present, or where claims compete or cultural risks exist (3.17.11); renewed consent for major changes (3.17.19). No forced eviction or relocation without prior consent and compensation (3.18.17); customary and Indigenous rights upheld in line with UNDRIP and ILO 169 (3.18.18)	FPIC required where Indigenous Peoples may be affected; the majority of adult community members must be reached (6.5.1)
Species composition	At least 3 species, none above 50% of living stems, each at least 5%; waived where fewer suitable species exist or for naturally single-species stands (PMM012 para 8(vi))	No diversity rule. Monocultures eligible, but VCS v5.0 bars invasive species (3.18.6), conversion of natural ecosystems except on evidenced degraded land (3.18.8), and requires restoration to improve ecosystem integrity (3.18.10–11).	At least five species from two or more genera; native species first, with natives holding the plurality; invasive species prohibited (6.4, 6.4.1)
Climate resilience	Species must suit the site and tolerate projected future climate over the crediting period (PMM012 para 8(vii))	Not specified in the methodology	Planting excluded where albedo change would cause net warming, unless evidence shows a net benefit (4.1)
Native ecosystems	PMM012: land must not have been forest in the 10 years before planting and must fall in one of 10 listed land categories. SD Tool: no explicit criterion on converting natural ecosystems; critical habitats only under set prerequisites including net gains (E3.3)	VM0047: site preparation may not clear natural forests, native tree species or commercially viable timber (§4.4.1, §8.2.1.2). VCS v5.0: conversion to intensive land use not permitted except for ARR and similar projects meeting set conditions, such as at least 10 years of evidenced high degradation (3.18.8–3.18.9); ARR restoration must move ecosystem integrity toward a justified reference or adapted state (3.18.10–3.18.11)	Degraded land, or non-forest land ecologically intended to hold forest; wetlands excluded (4.1)
Biodiversity	SD Tool: protect and conserve biodiversity (E3.2.2); no negative impacts on endangered species or protected areas (E3.2.4); do not introduce alien species into new environments and prevent the spread of established ones (E3.2.6–E3.2.7)	Avoid or minimise negative impacts on biodiversity and ecosystems; protect habitats of rare or endangered species (3.18.4–3.18.5); do not introduce invasive species or allow them to thrive (3.18.6); minimise soil degradation, erosion and water stress (3.18.7). Optional CCB Standards certification adds verified net climate, community and biodiversity benefits, shown as a CCB label on the VCUs	Rare, threatened or endangered species populations must not decline; degradation of rare ecosystems no more than 10%, hard cap 30%; failing to protect a High Conservation Value can stop crediting (6.3)

	A6.4-PMM012 v1.6 via Article 6.4 rules	VM0047 v1.1 via VCS programme rules	Isometric Reforestation v1.1
Soil and nutrients	Synthetic nitrogen fertiliser prohibited; soil disturbance limited to 10% of the area; SOC excluded from accounting	N_2O from fertiliser counted as a project emission; SOC accounted where disturbance triggers it; census approach limits soil inversion to 25 cm, once per crediting period	SOC excluded from accounting; synthetic fertilisers and herbicides should not be used (6.7)
Benefit-sharing	PMM012: landowners or carbon-right holders who are not the registrant receive a fair share aligned with local land-lease rates; binding agreements shared confidentially with the DOE (para 103). SD Tool: equitable benefit sharing with Indigenous Peoples through good-faith negotiation (E9.6)	Benefit-sharing mechanism designed jointly with rights holders before project start (3.17.12); project infrastructure, safeguard mitigation and worker salaries do not count as benefits (3.17.15); written implementation agreement signed in English and a language the rights holders understand (3.17.17). Workers paid at least the regionally prevailing industry wage (3.18.21)	Community benefit-sharing strongly encouraged but not prescribed; revenue-sharing agreements must be public (6.5.2.2)
Participation and grievance	Local and global stakeholder consultation before registration and continued engagement after (mandatory for all activities); Indigenous Peoples' full and effective participation in the safeguards assessment (E9.2). Grievances go to the mechanism-level Appeal and Grievance Procedure, in force since May 2024. PMM012 adds that Participatory Rural Appraisal may be used (para 104)	Stakeholder identification with attention to women, marginalised and vulnerable people (3.17.1); engagement plan updated each verification (3.17.2); in-person meetings in community-approved locations, free from coercion (3.17.4); public input tracker (3.17.6); project-level grievance mechanism before project start, acknowledgement within 21 days, escalating from good-faith resolution to mediation to arbitration or courts (3.17.22–23); independent stakeholder interviews by the VVB (4.1.14)	Grievance process defined in the project design document, with a third party helping to address grievances (6.5.2.1)
Sustainable development claims	SD Tool sustainable development impact form, verified by the DOE	Mandatory at programme level: quantified contributions to targets and indicators of at least three SDGs (one may be SDG 13) in every monitoring period, aligned with the host country's SDG objectives (VCS Standard v5.0, 3.16). Alternatively, met by concurrent CCB or SD VISta verification, which adds a label to the VCUs.	No separate certification. Water safeguard: projects in high water-risk basins must assess whether annual water yield falls by more than 1% and plan mitigation (6.6)

NOTES

1. Isometric has since published v1.2, with v1.3 in public consultation. Judging from the v1.2 change markup, its quantification rules, dynamic baseline, buffer, reversal rules and leakage default values are unchanged. The relevant changes tighten eligibility and safeguards:
   - Deforestation in the 10 years before project initiation is prohibited, and the exceptions for natural disasters or non-industrial common practice now need land-use history and a review of regional deforestation patterns.
   - Historical forest presence must be evidenced (one of five evidence types, including traditional ecological knowledge), and land-cover data must be public, over 90% accurate, 30 m or finer and cover at least 10 prior years.
   - Projects must describe safeguards against clear-cutting for timber, including after the monitoring period ends.
   - Stronger land tenure evidence, consent for trust-held and multi-owner land, binding obligations on land transfer, and a financial model covering the full commitment period.
   - Stakeholder consent may be withdrawn or made conditional; synthetic pesticides are limited to non-native pests or invasive outbreaks under FSC's Pesticides Policy.
   - Secondary climate effects, excluded in v1.1, must now be quantified and assessed for materiality. "Credits" are renamed "Certificates".